Assemble the Engine

an I-DEAS Exercise in Solid Modeling

by

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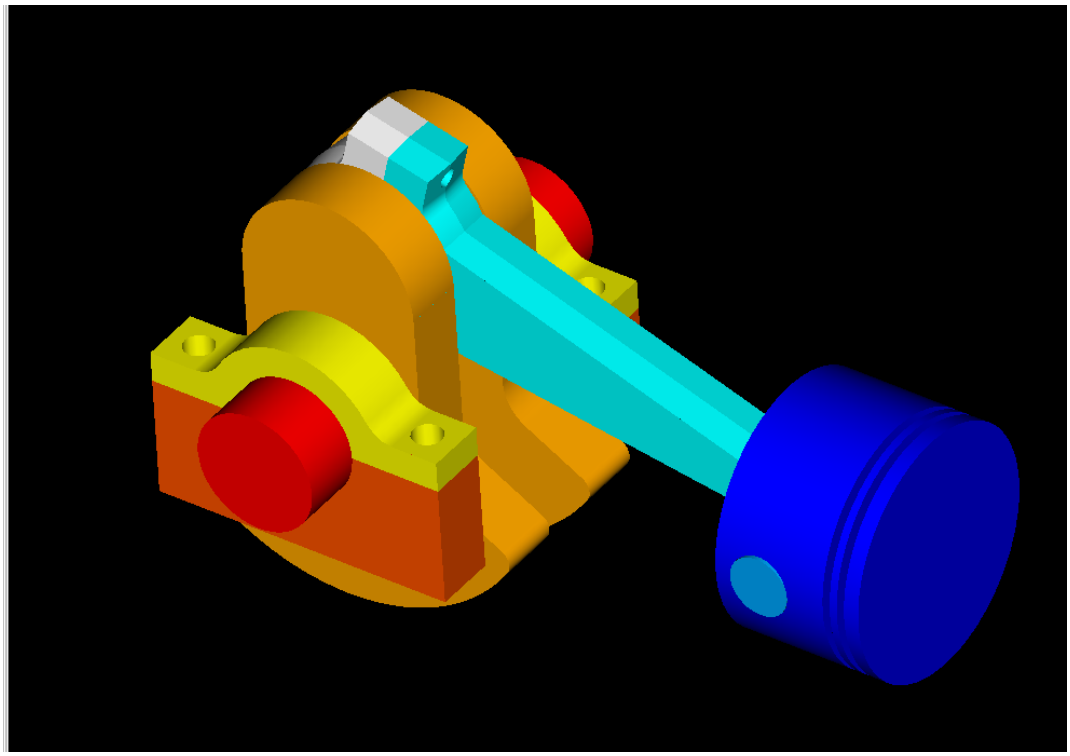
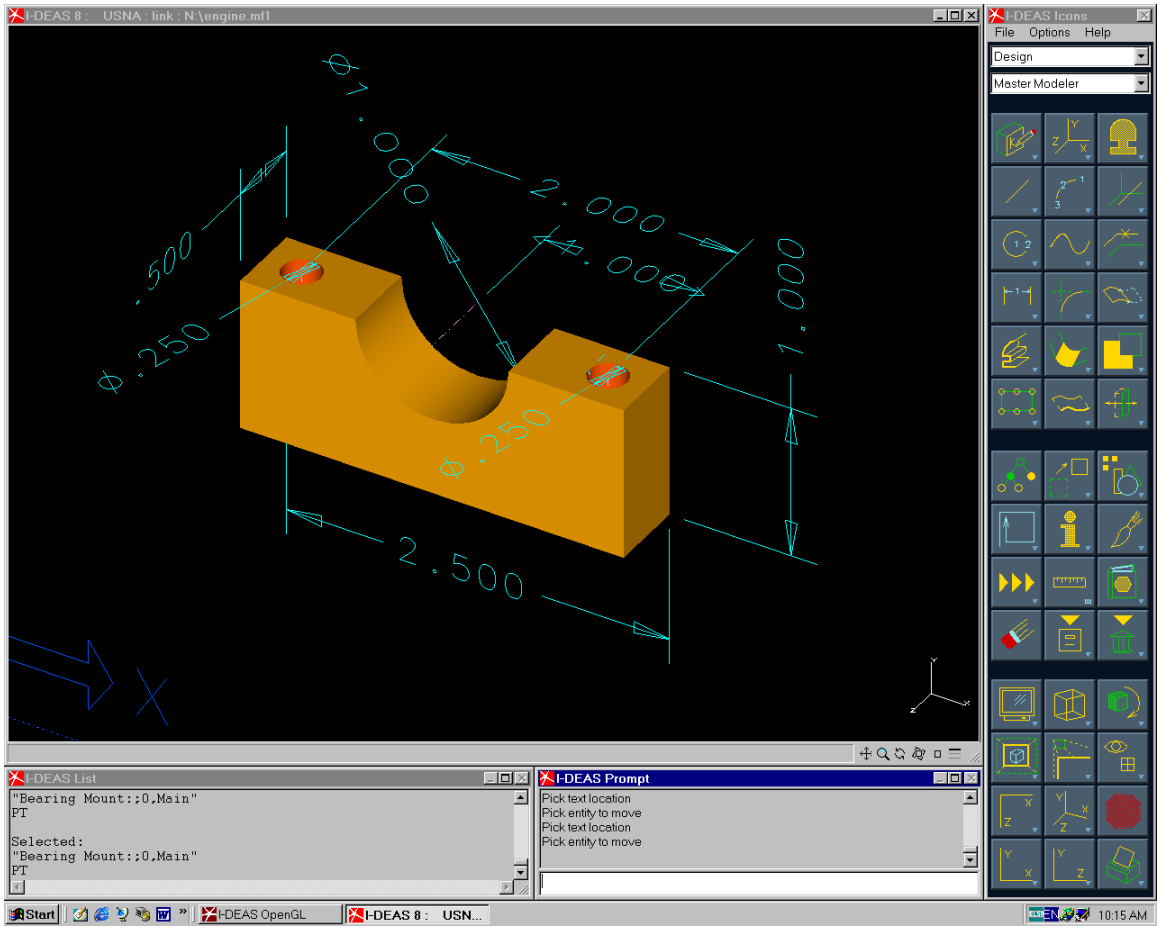


Assemble the Engine

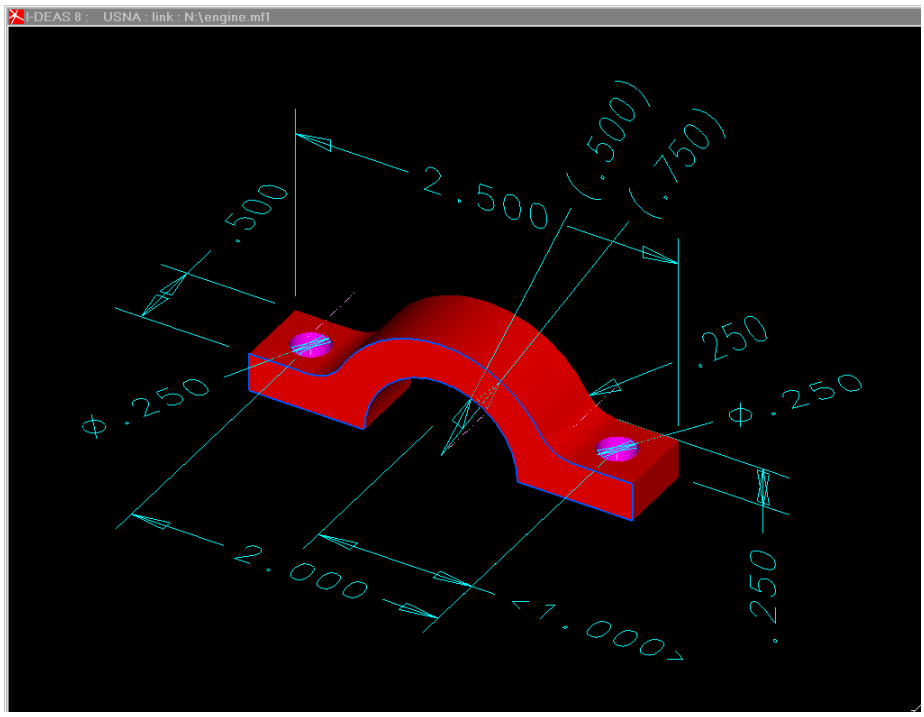
In this exercise you will build a model of a crankshaft for an engine. Here are some tips to remember when going through the exercise:

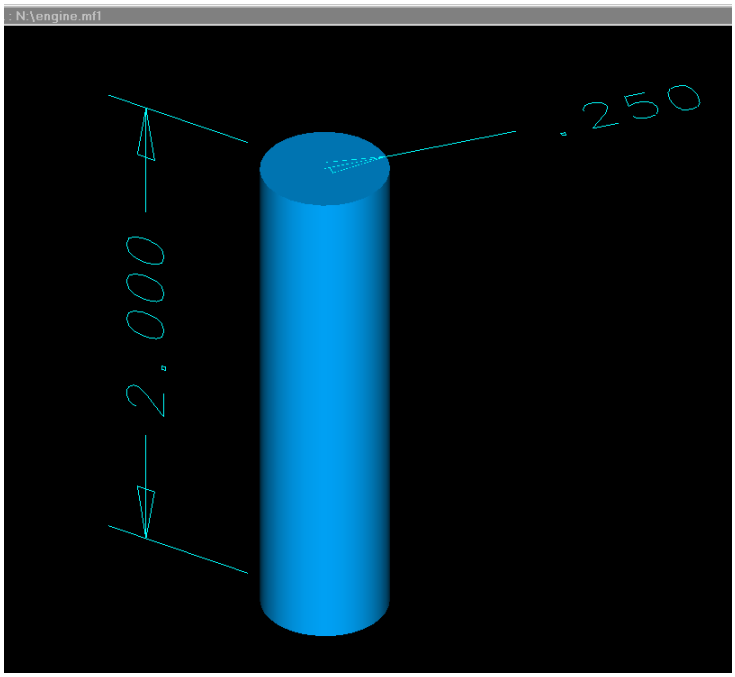
- Pay attention to the I-DEAS List and Prompt regions at the bottom of the large display window. The prompt region asks you for feedback or to select entities, the List region provides information.
- You can elect the default response from the prompt region by clicking the center mouse button. The button assignments are:
  - Left button - pick or select
  - Center button - Done or OK or accept default
  - Right button - display list of options for current command
- Save your work after the completion of every successful step. If you make a mistake on the next operation, you can recover to the model state from the last *Save* by typing *Ctrl-z*. There is no general Undo feature in I-DEAS!
- Use the Dynamic Viewing buttons (F1-Pan, F2-Zoom, and F3-3D Rotate) to adjust the display while you are in the middle of a command to help you select the entity you want. Hold the appropriate button down and drag the mouse in the display region.

1. On your own, make the object shown below and name it *Bearing Base*. Put it away in your bin.

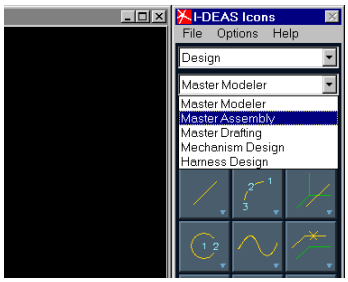


2. Make the object shown below and call it *Bearing Cap* and put it away in your bin. Also make the cylinder shown in the lower picture, call it *Piston Pin* and put it away. Save your model file.

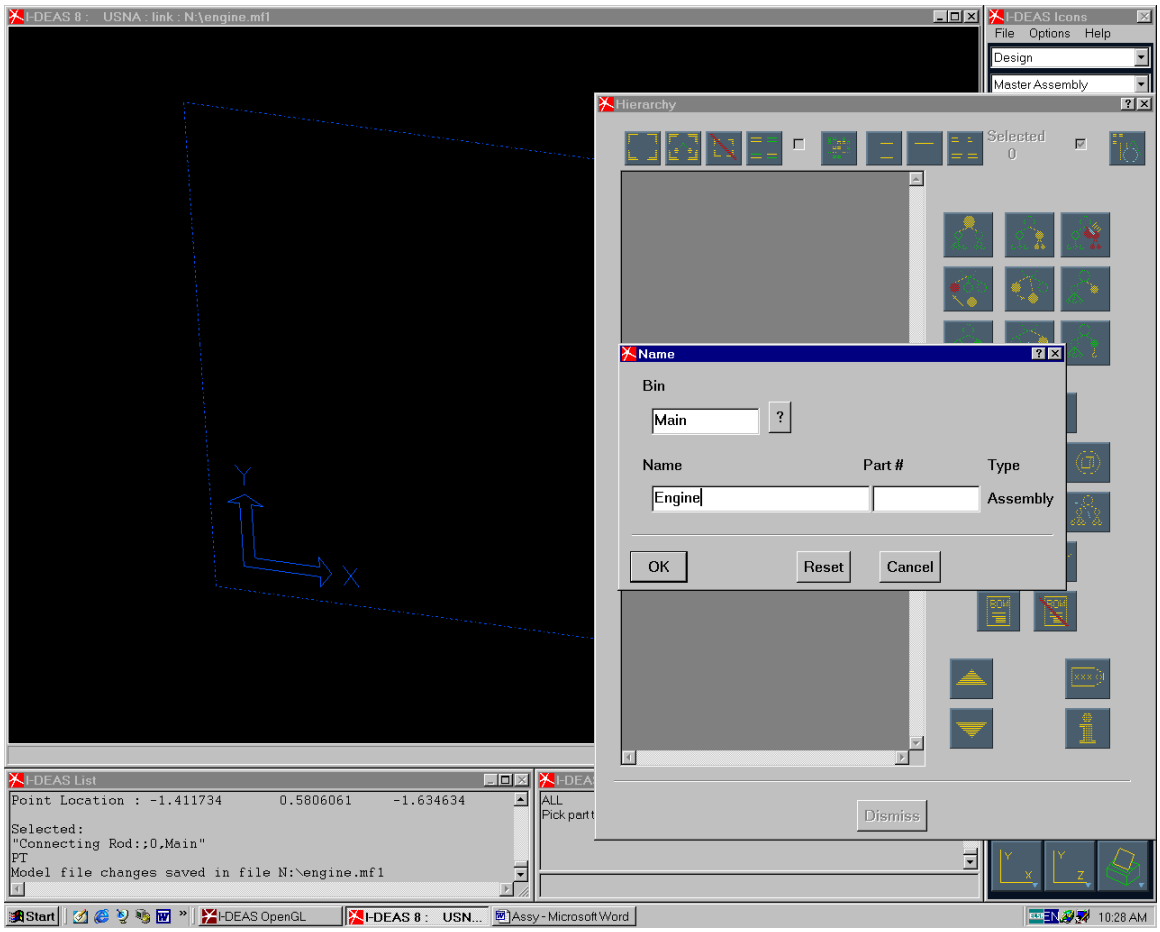




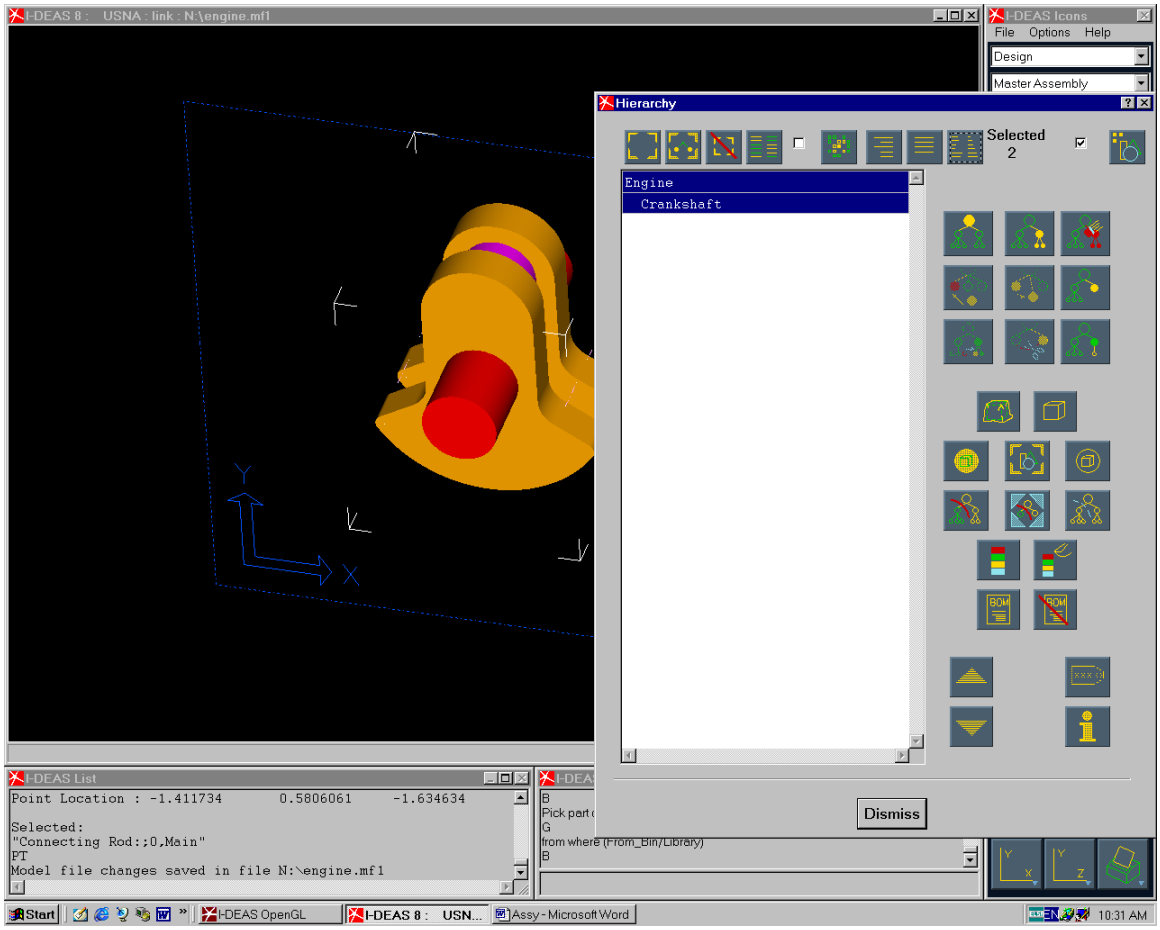
3. Switch to **Master Assembly**.



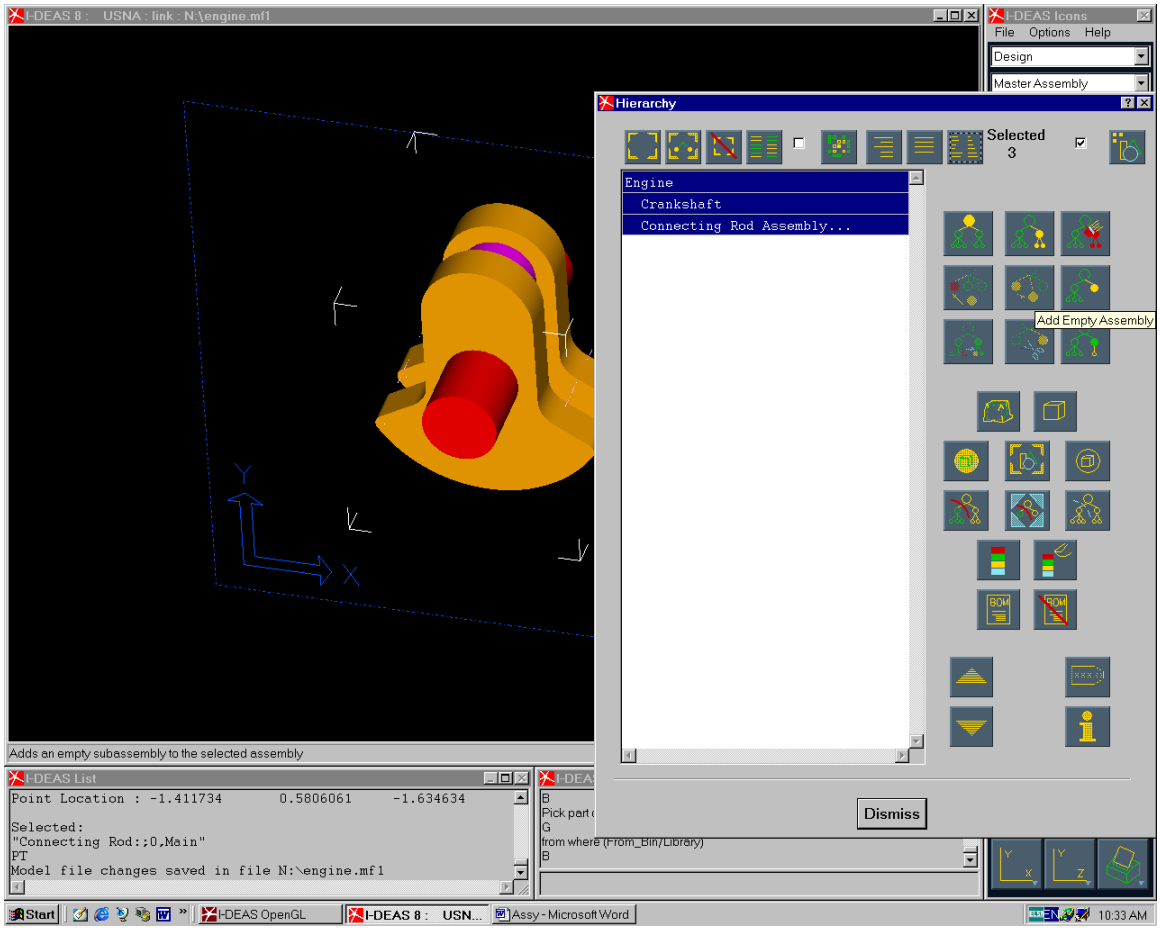
4. Pick the **Hierarchy** icon, create a top-level assembly and name it *Engine*.



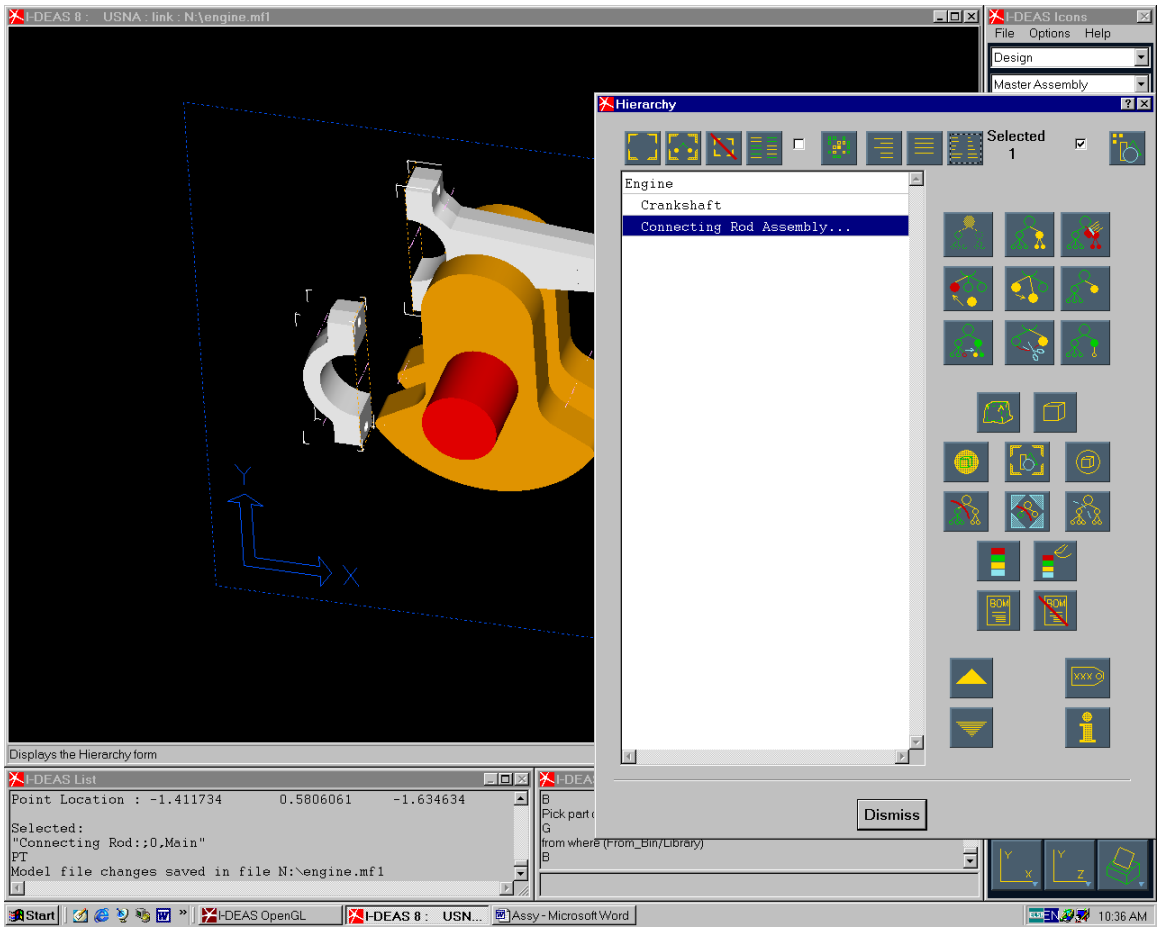
5. Select the top-level assembly on the form, pick the **Add Instance to Assembly** icon, **RMB, Get…, From Bin/Library** and select the Crankshaft, pick **OK**



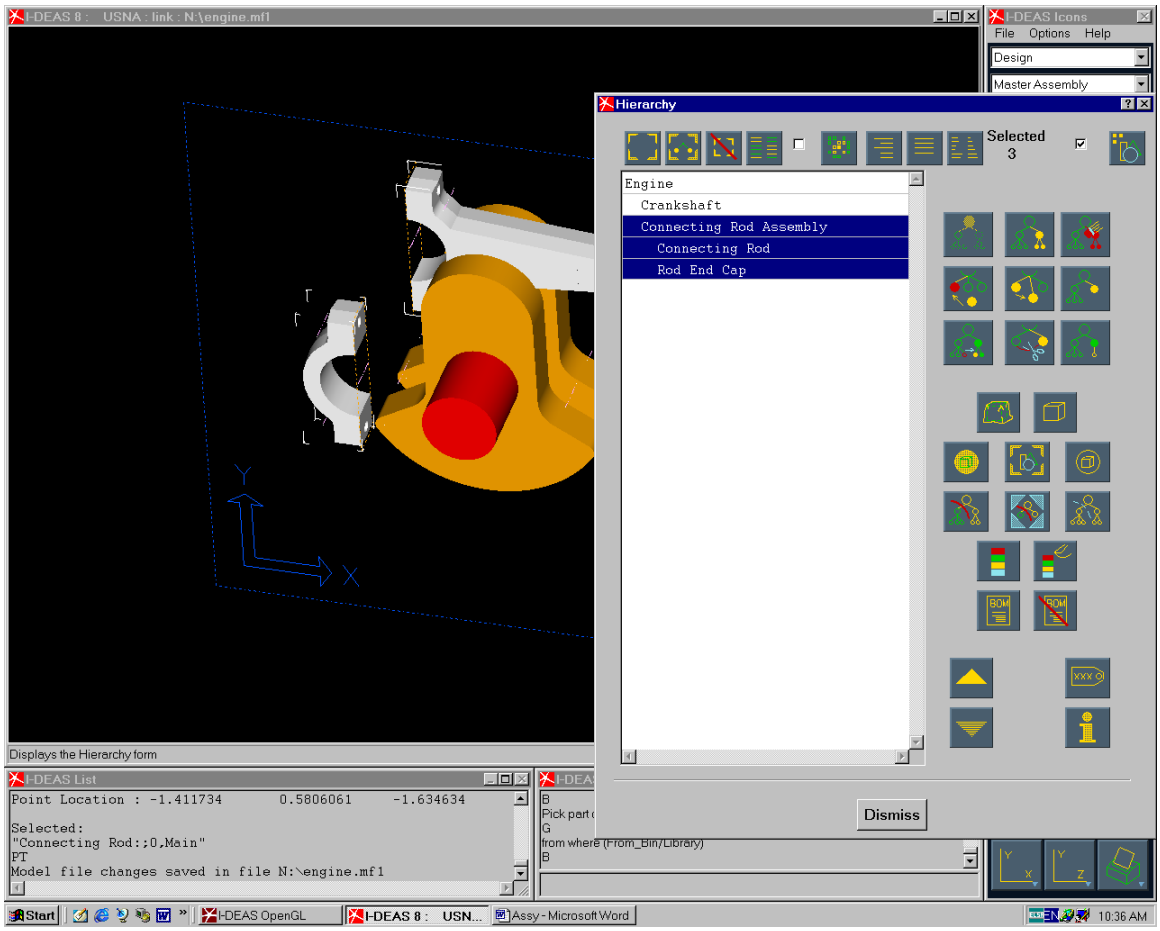
6. With *Engine* still selected, pick the icon to **Add an empty subassembly/instance** to the main assembly, call it *Connecting Rod Assembly*



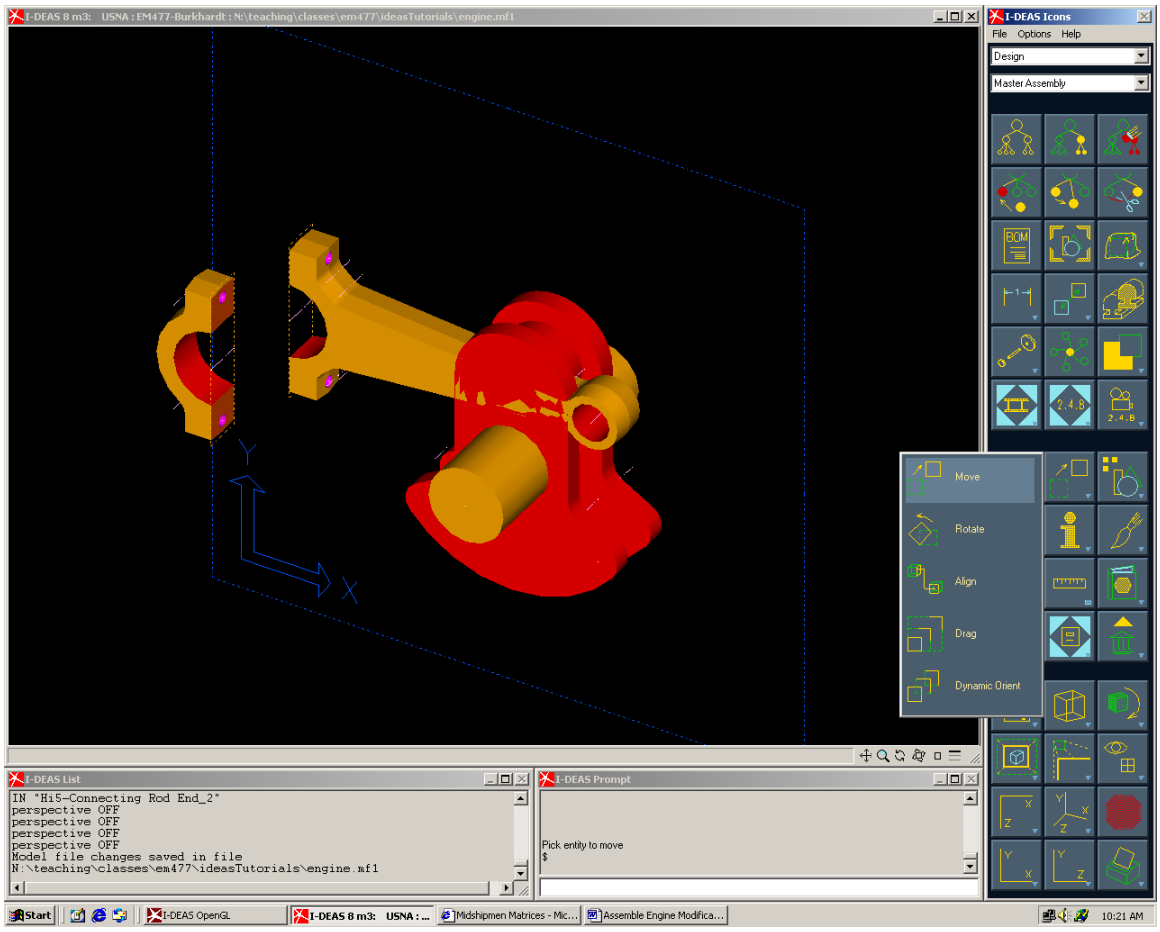
7. Select *Connecting Rod Assembly*… and add an instance of the Connecting Rod and the Rod End Cap to it. Pick the icon, **RMB, Get, From Bin/Library**, select *Connecting Rod*, hold down the **Ctrl** key and select *Rod End*, then **OK**



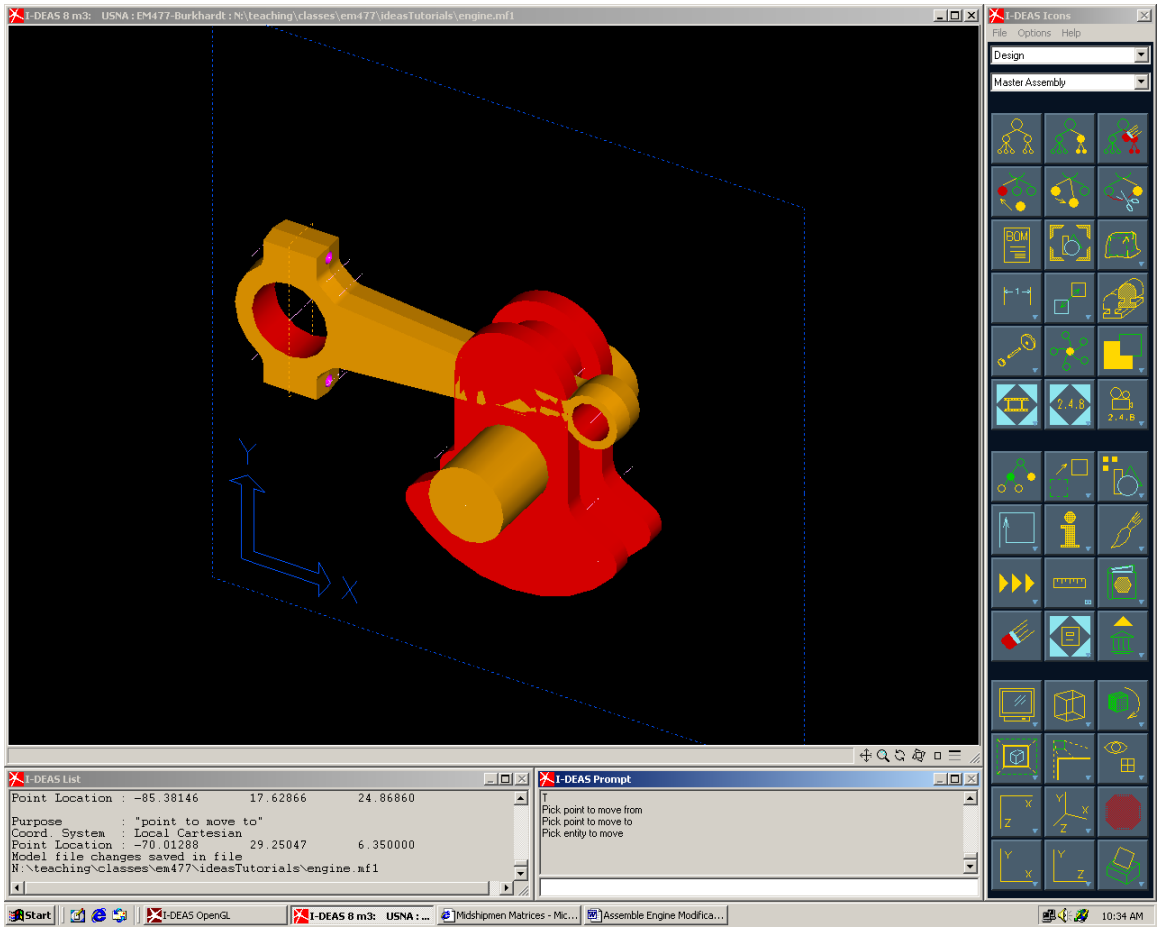
8. Double click on *Connecting Rod Assembly…* to expand the list and see that the Connecting Rod and Rod End Cap are both parts of the subassembly.



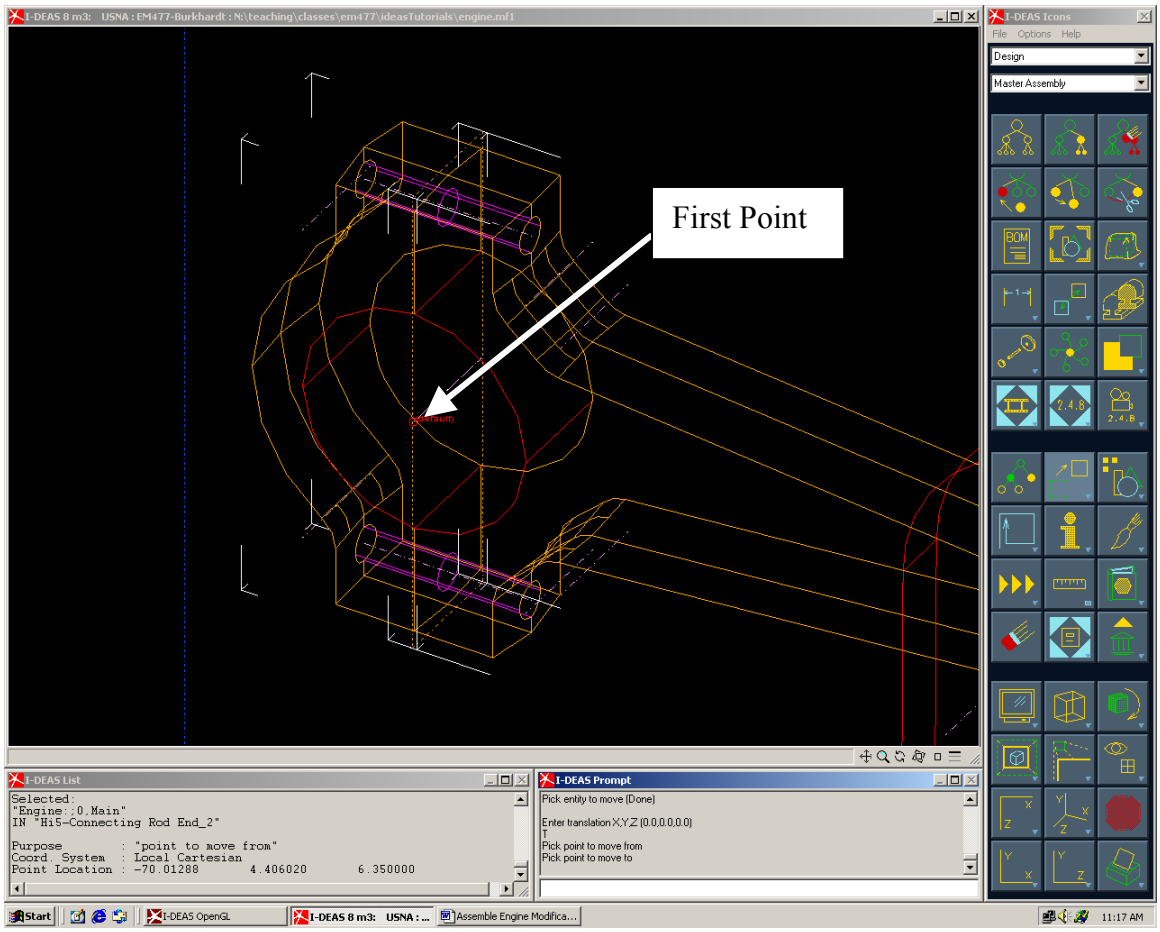
9. In general, parts will not be properly positioned in space. They will probably overlap. We will need to reposition the parts with respect to one another before we can continue. Dismiss the Hierarchy form and pick the **Move** icon to display the Move icon panel.



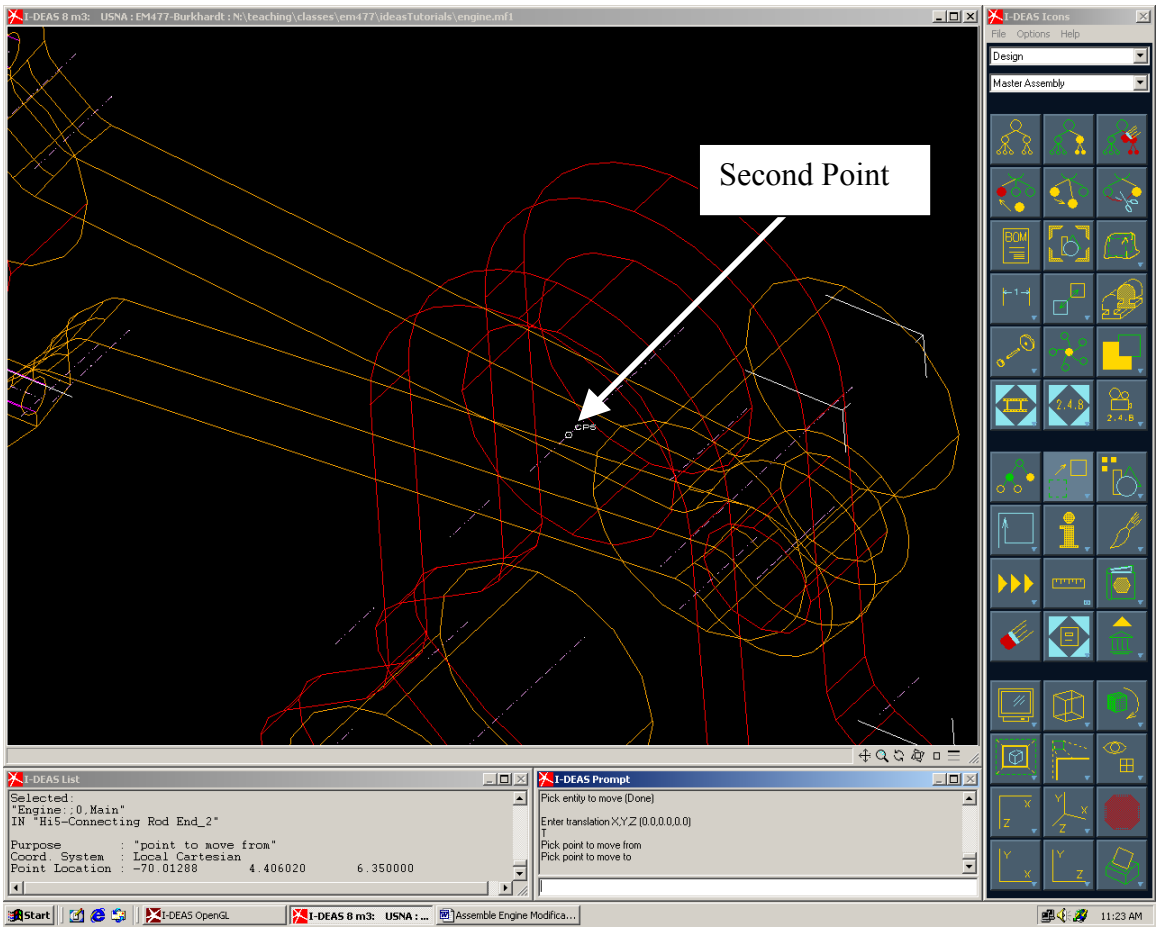
10. The Connecting Rod End and Connecting Rod are probably properly aligned. If not move the rod end cap so that it aligns with the connecting rod by picking the **Move** icon, selecting the end cap and choosing the *Move To* option. Now chose a point on the end cap and then a point on the connecting rod that should be adjacent. **Save your model file.**



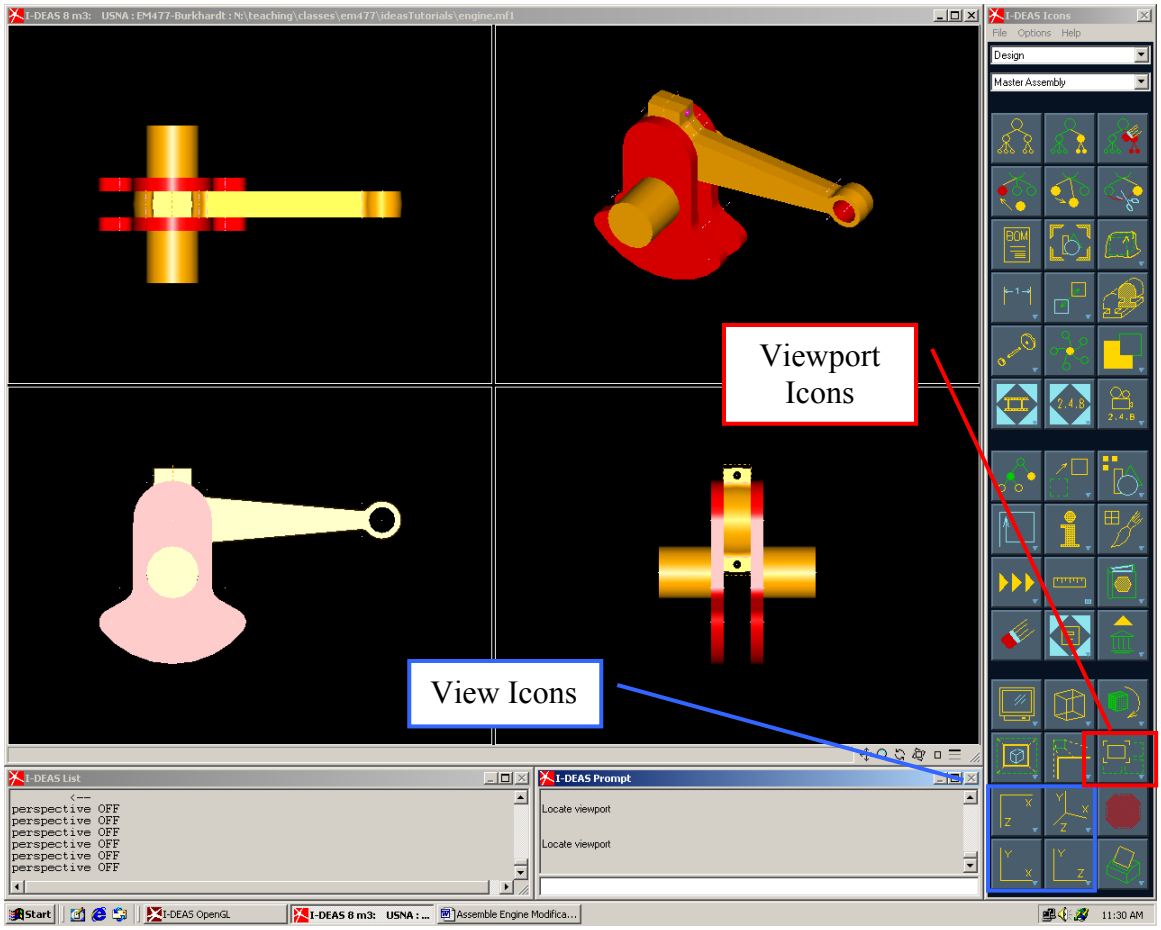
11. Now position the connecting rod on the crankshaft. This can be done in one step, even if the objects lay in different planes, using the **Move**, *Move To*, operation used previously. Display the assembly as a wire frame. After selecting the **Move** icon, select both the rod end and the connecting rod using the **Shift** key. Now pick the center of the near circle formed by connecting rod and connecting rod end.



12. For the second point choose the center of the circle on the inside of the near counterbalance as the “point to move to.”

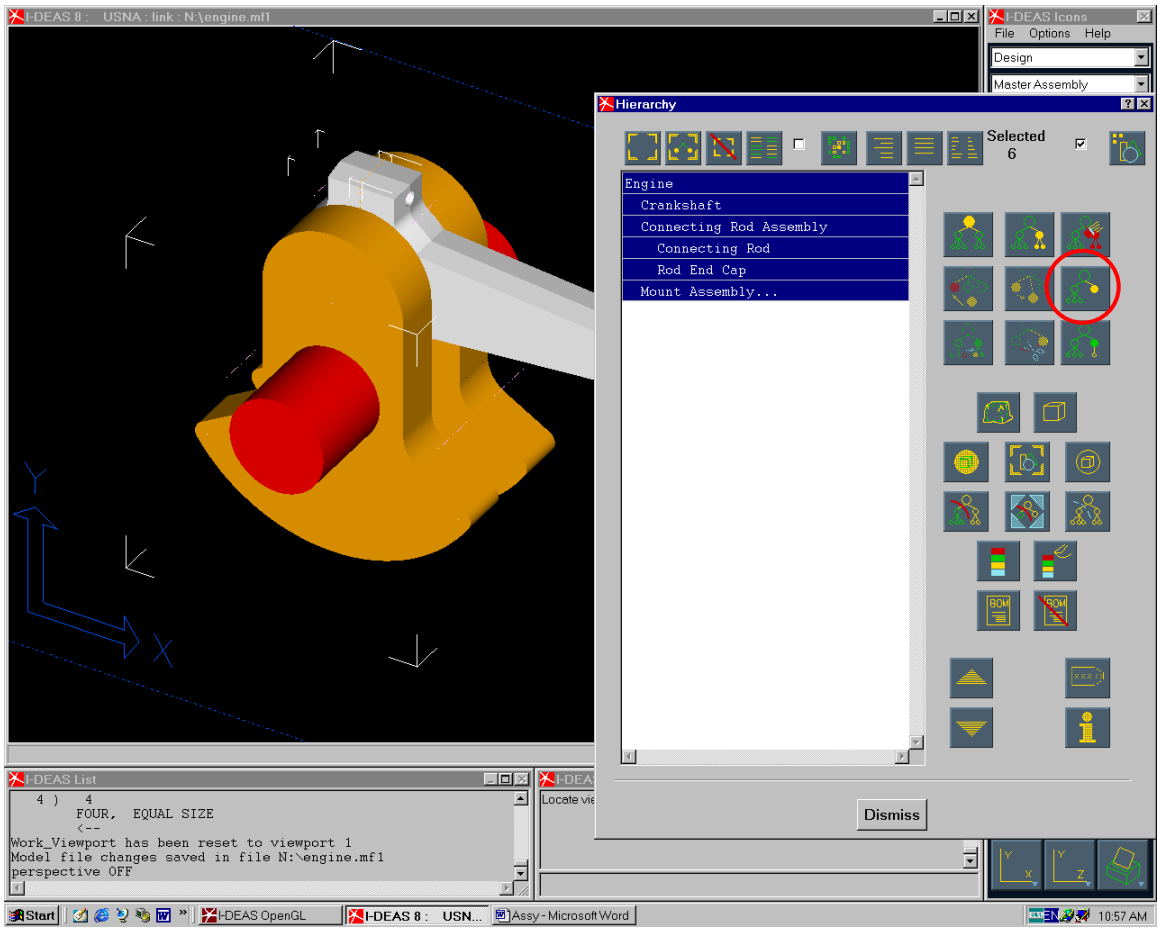


13. View the assembly from different directions to make sure that the parts are properly positioned. If not, use *Ctrl-z* to return to your previously saved model or re-**Move** the part.

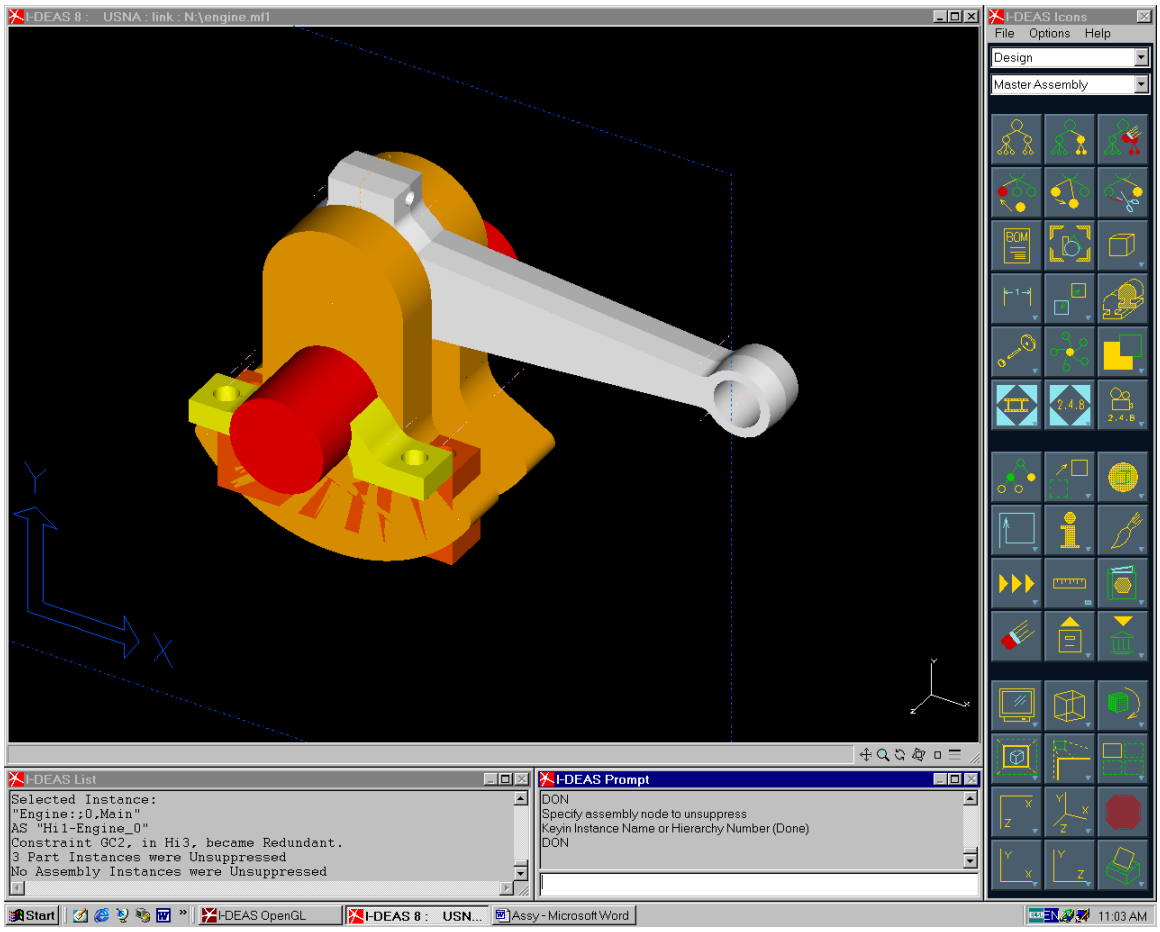


You can produce this view by selecting the **Four Viewports** Icon. Then use the **Work Viewport** Icon in combination with the **View Icons** to select each of the four views and assign the appropriate view.

14. Display the Hierarchy form, select the top-level assembly and then pick the **Add Empty Subassembly/Instance** icon. Name the subassembly, "*Mount Assembly*"

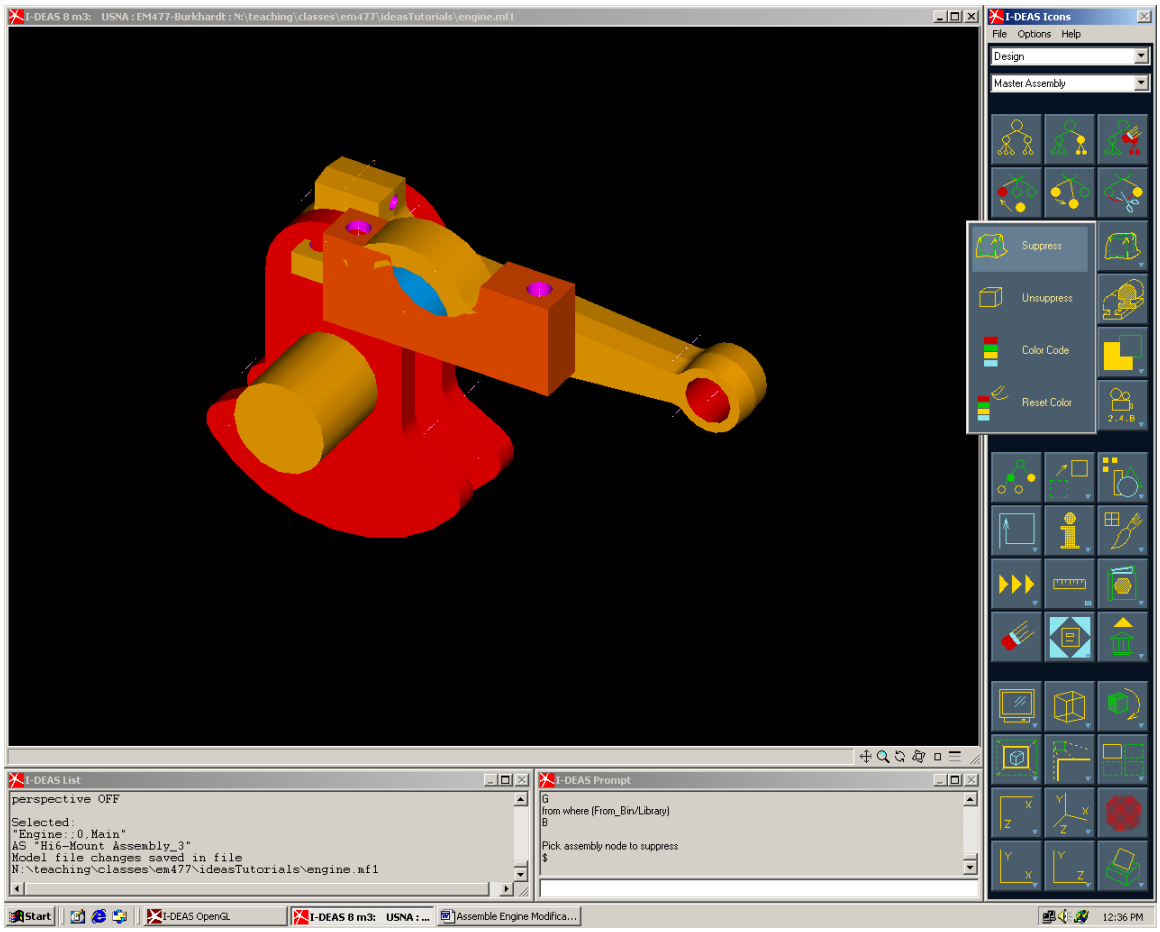


15. Pick the *Mount Assembly…* entry and then pick the **Add instance to assembly** icon. **RMB Get, From Bin/Library** and select the *Bearing Base*, hold the **Ctrl** key and select the *Bearing Cap*. Click **OK**. The parts probably overlap each other.

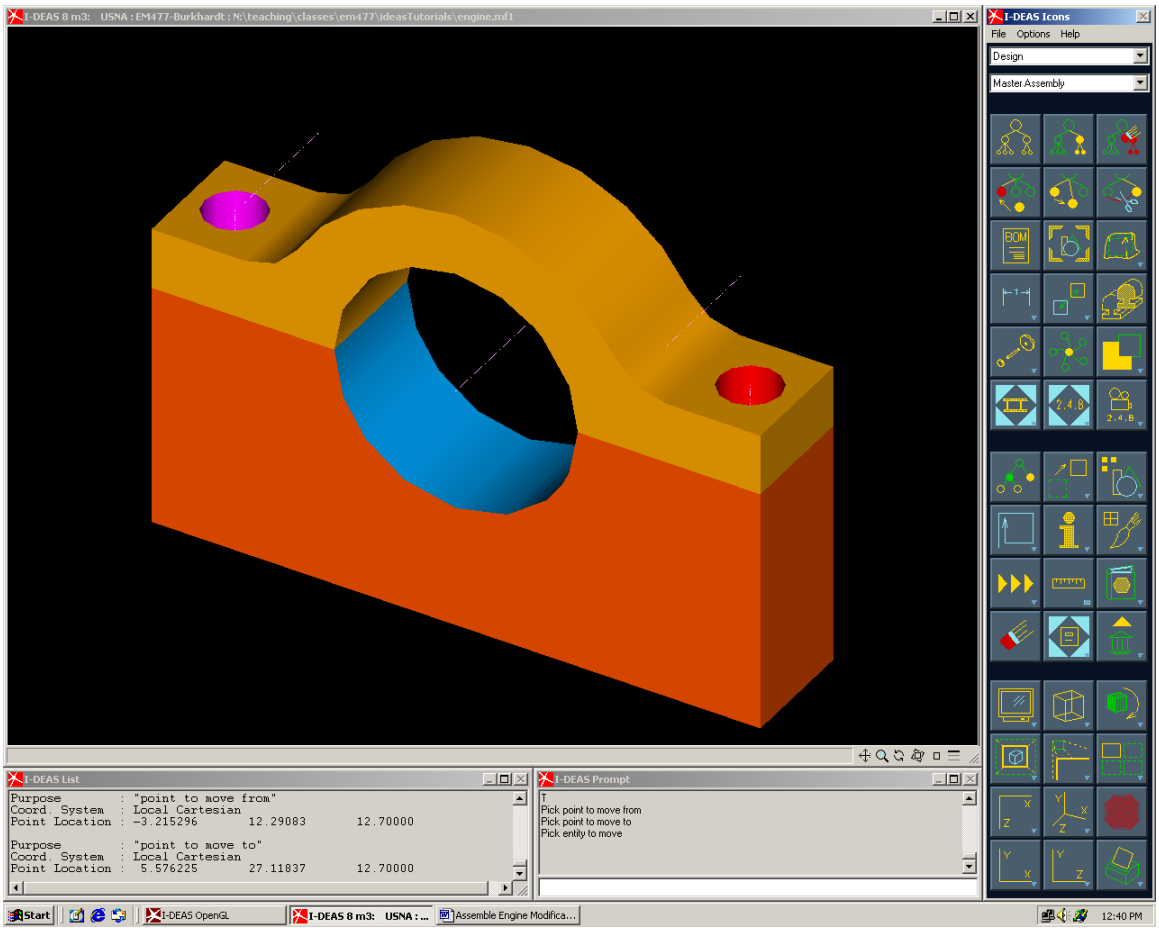


16. You will need to reposition the Bearing Cap and the Bearing Base with respect to each other and the Crankshaft. Start by suppressing the Crankshaft and Connecting Rod instances. Pick the Suppress icon, then hold the Ctrl key while you select the Crankshaft, Connecting Rod and End Cap, then MMB (Done).

Save your file often so you can recover from any errors.

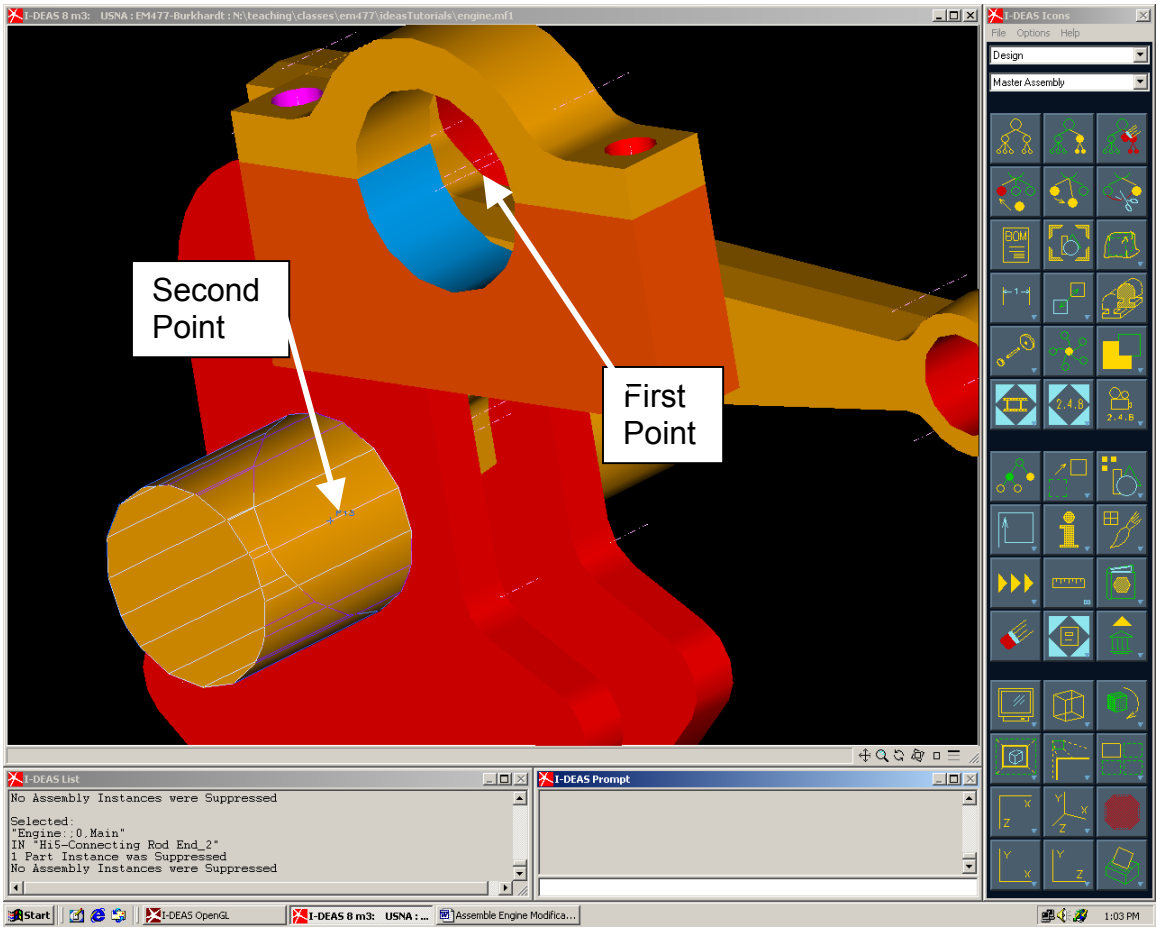


17. The display should be less cluttered now and you can move the Bearing Cap to the Bearing Base. Select the **Move** command and pick the Bearing Cap. Select the *Move To* option and pick a point on each part that should be coincident.

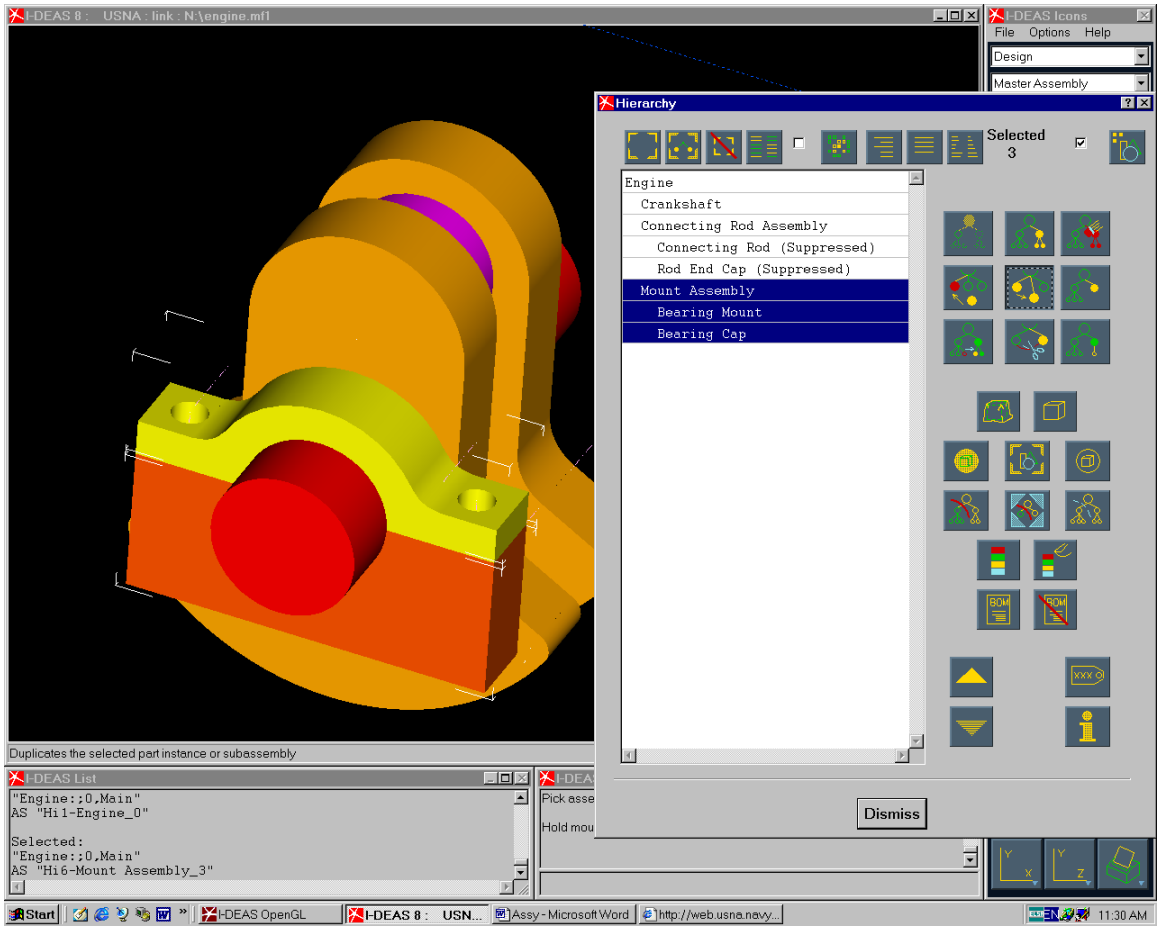


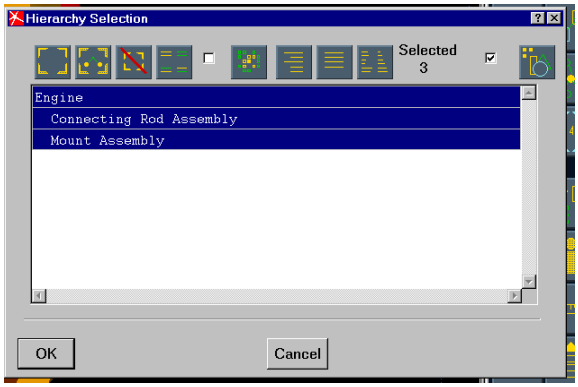
18. Unsuppress the Crankshaft so that we can align the Mount Assembly with the Crankshaft journal.

19. Align the Mount Assembly with the Crankshaft journal using the **Move** command with the *Move To* option. After selecting the Bearing Base and Bearing Cap select the center of the rear circle formed by the Mount Assembly as the first point and the center of circle formed by the intersection of Crankshaft journal with the Crankshaft counterweight as the second point. The use of Dynamic (F1, F2, F3) Navigation may be helpful.

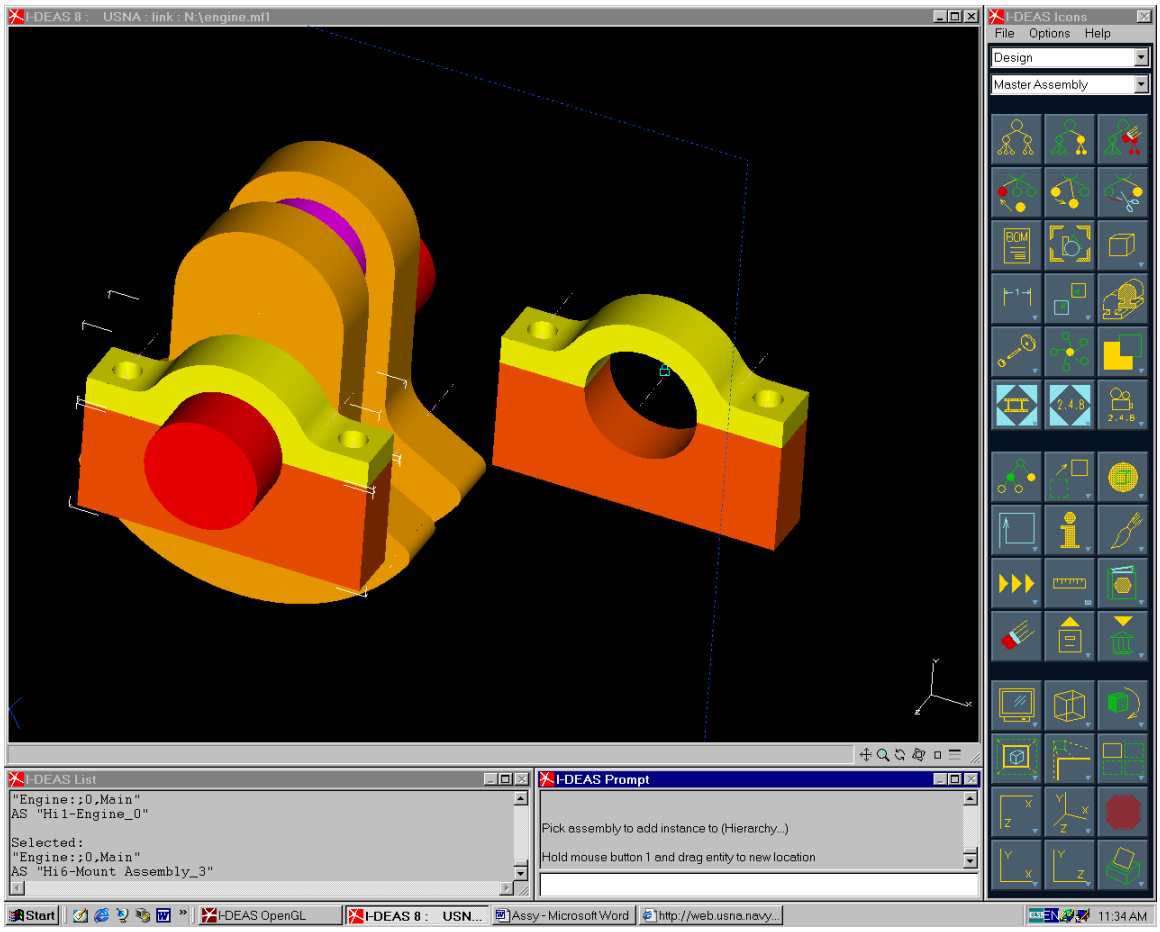


20. Create a duplicate instance of the Mount Assembly for the other crankshaft journal. Pick the **Hierarchy** icon. Select the *Mount Assembly*, pick the **Duplicate instance** icon. The Prompt region will ask you to “Pick assembly to add instance to (Hierarchy…) Click **MMB** to display the form, then select *Engine* and **OK**

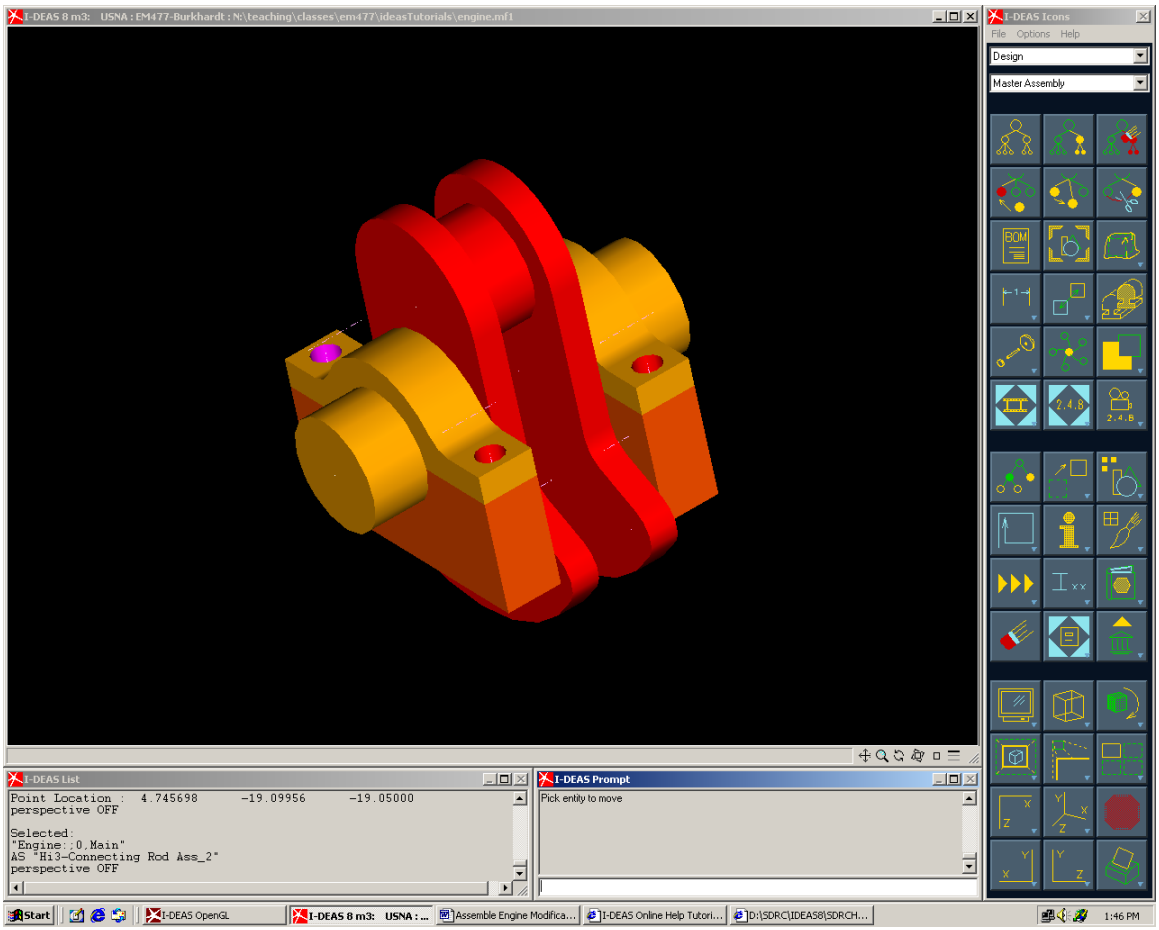




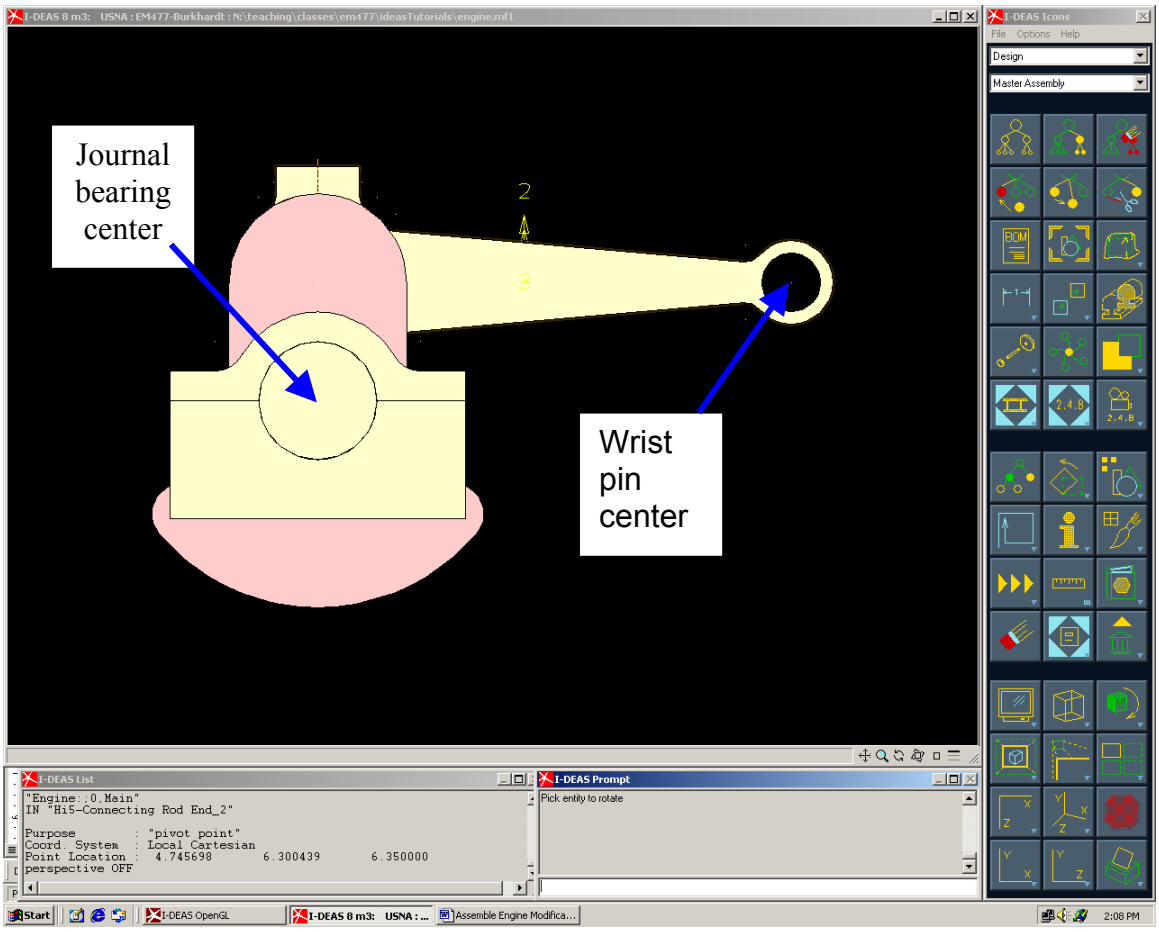
21. The prompt region will ask you to hold LMB and drag entity to new location. Drag the duplicate to a position away from the crankshaft so that you can move it easier in the next step. Dismiss the Hierarchy form after dragging the new Mount Assembly.



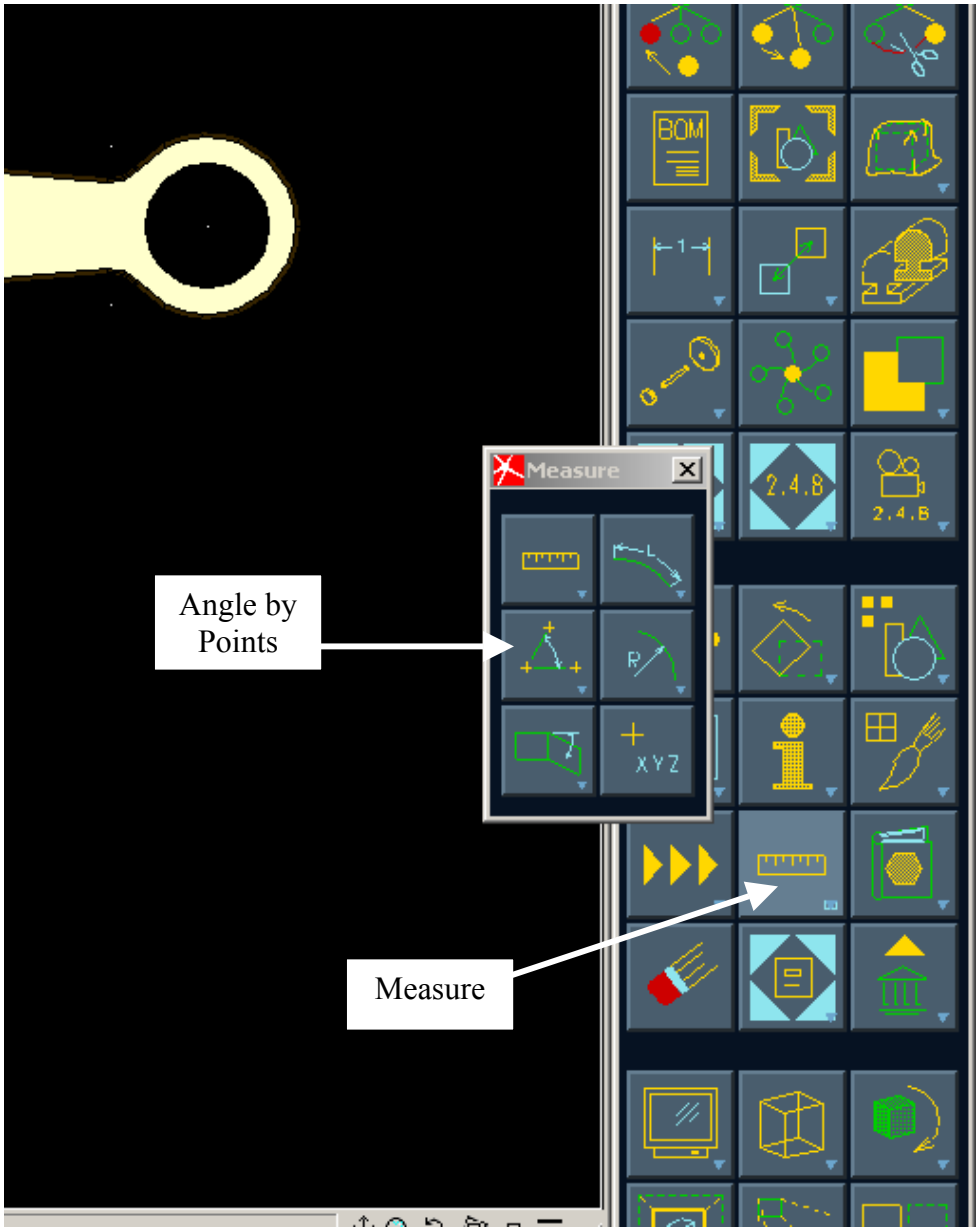
20. On your own reposition the new mount to be properly positioned along the other crankshaft journal as shown below. After selecting the **Move** icon use **RMB** to select hierarchy. Be sure to select only the Mount Assembly you wish to move.



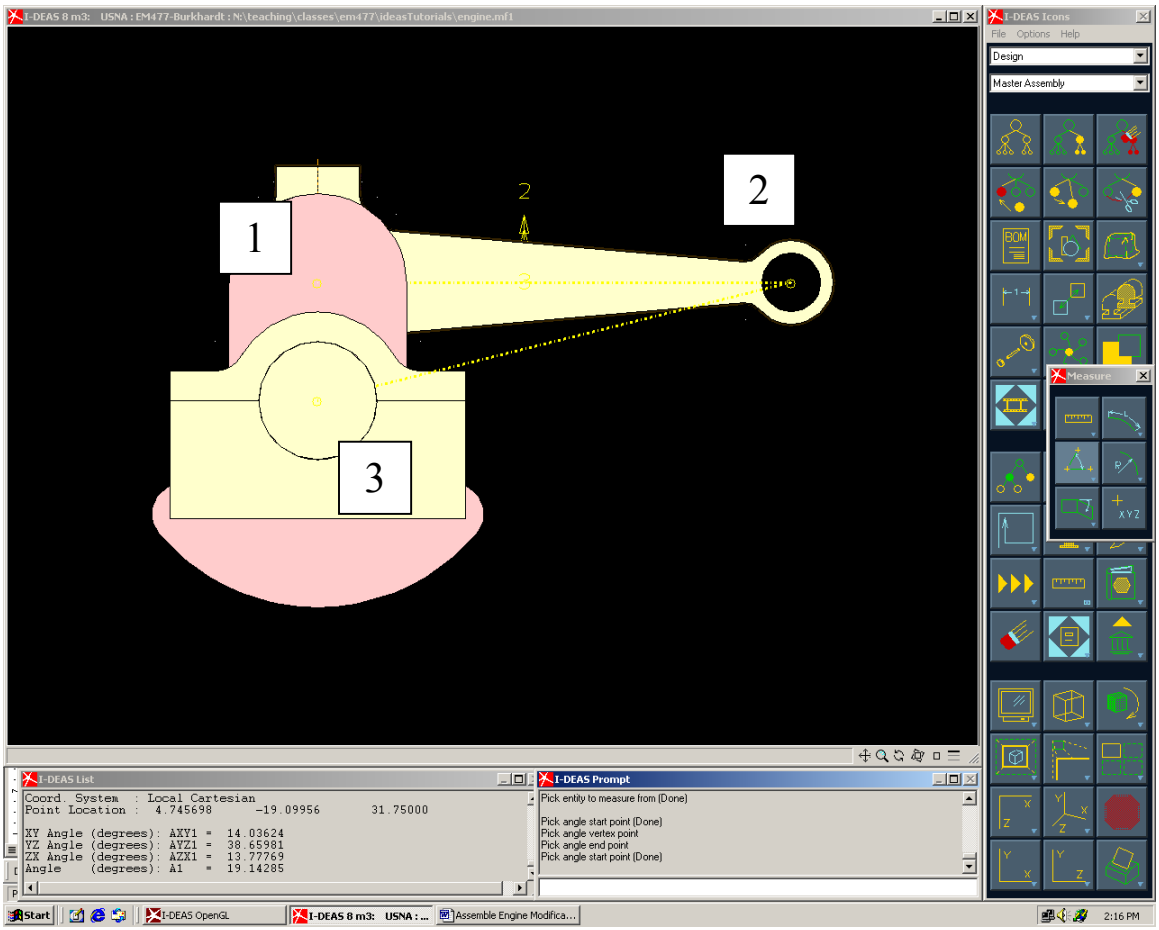
21. Unsuppress the Connecting Rod Assembly. Now rotate the Connecting Rod and Connecting Rod End clockwise so that the center of the wrist pin lies in a plane with the center of the Crankshaft journal bearings.



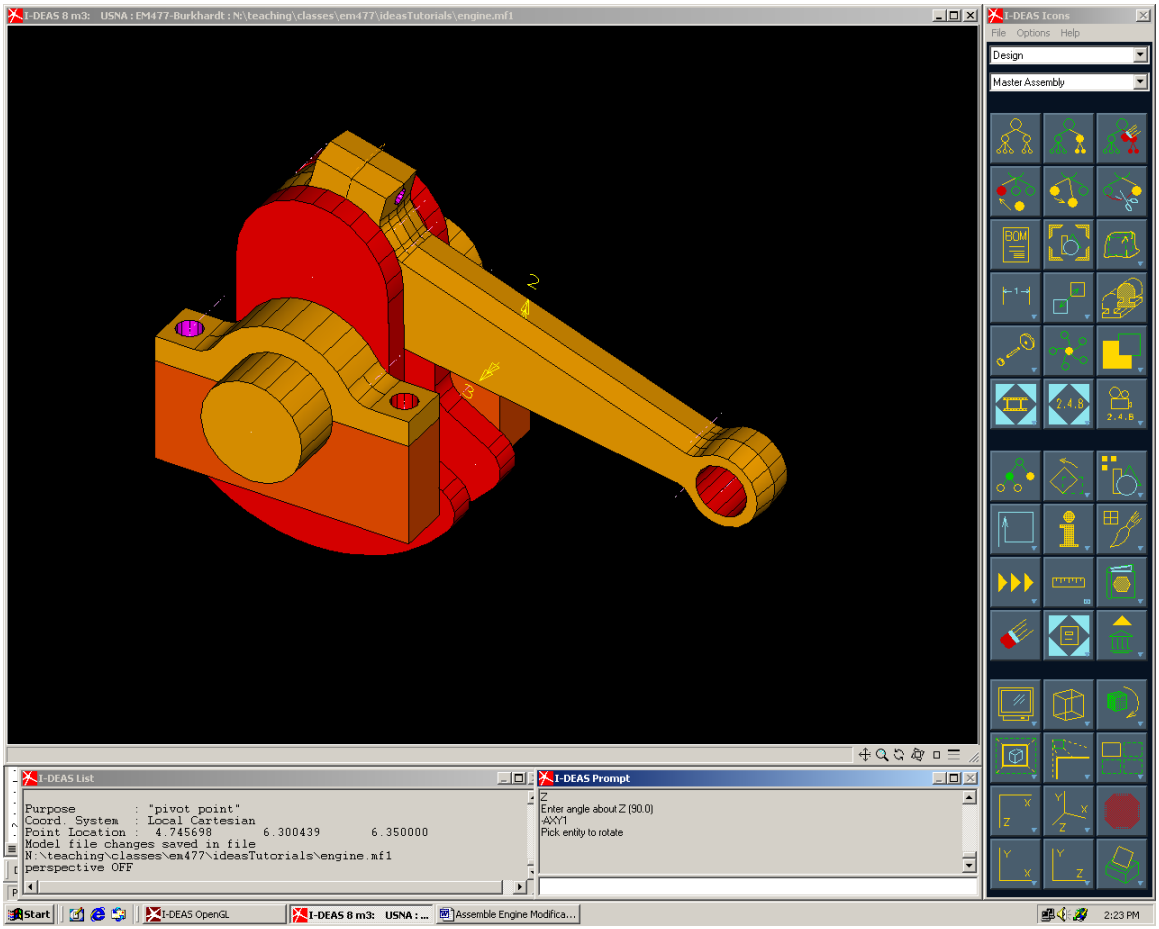
22. First measure the required angle of rotation by choosing the **Measure** icon followed by the **Angle by Points** icon.



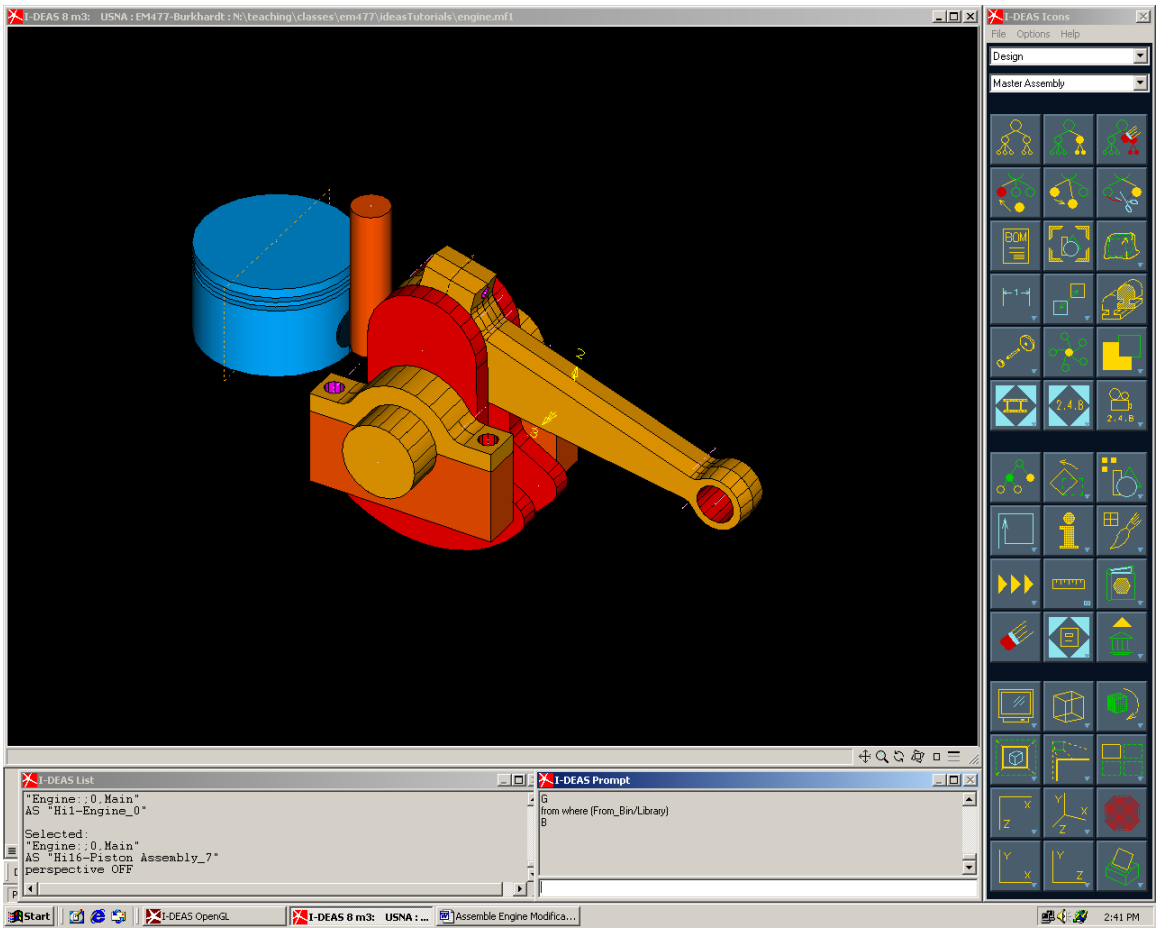
23. Chose the points in the order shown below: 1, center of the connecting rod bearing; 2, center of the wrist pin bearing; 3, center of the crankshaft bearing. Note the angle AXY1 in the Ideas List area … that is the angle of interest.



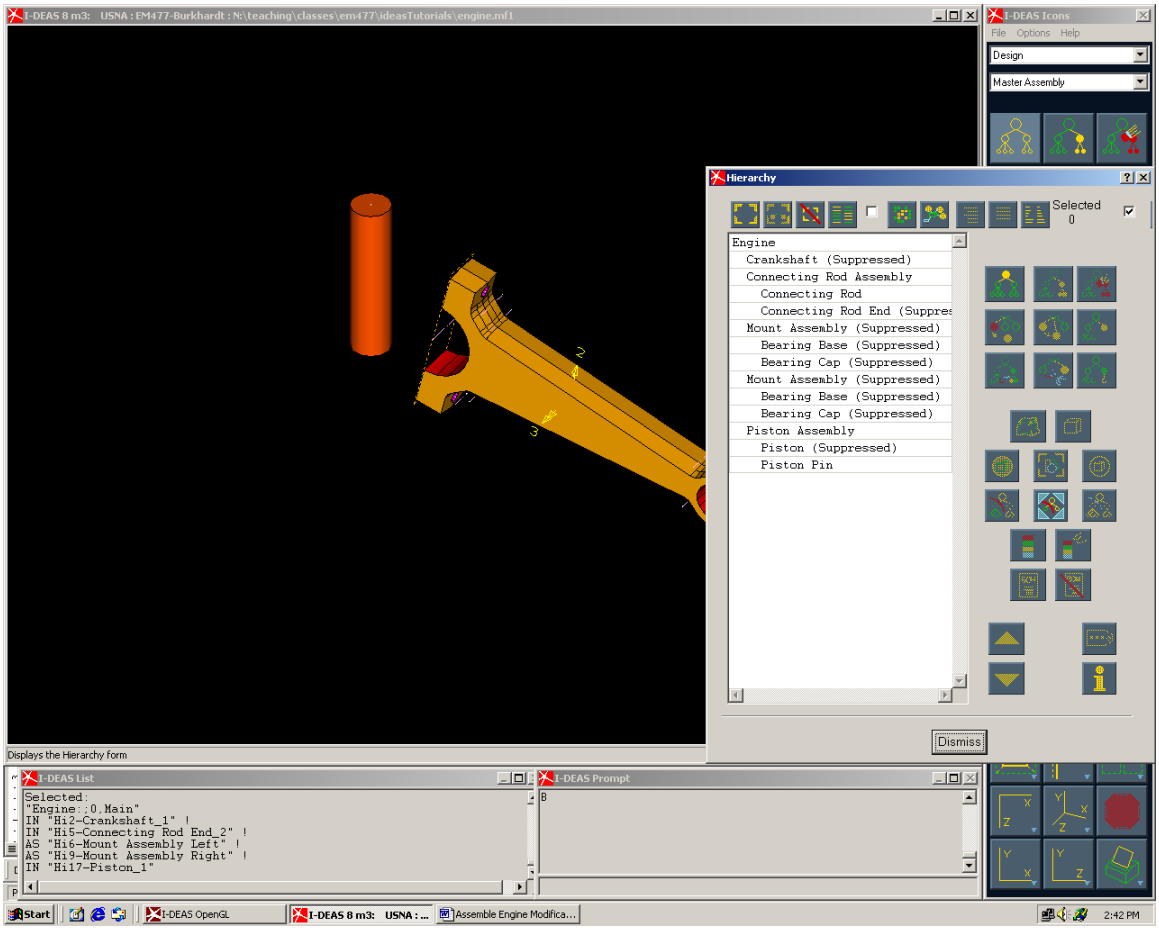
24. Now rotate the Connecting Rod and Connecting Rod End using the **Rotate** command located in the **Move** icon sub panel. When asked for the angle use the variable name associated with it. Be sure to select both the rod and the rod end as well as to account for direction or rotation.



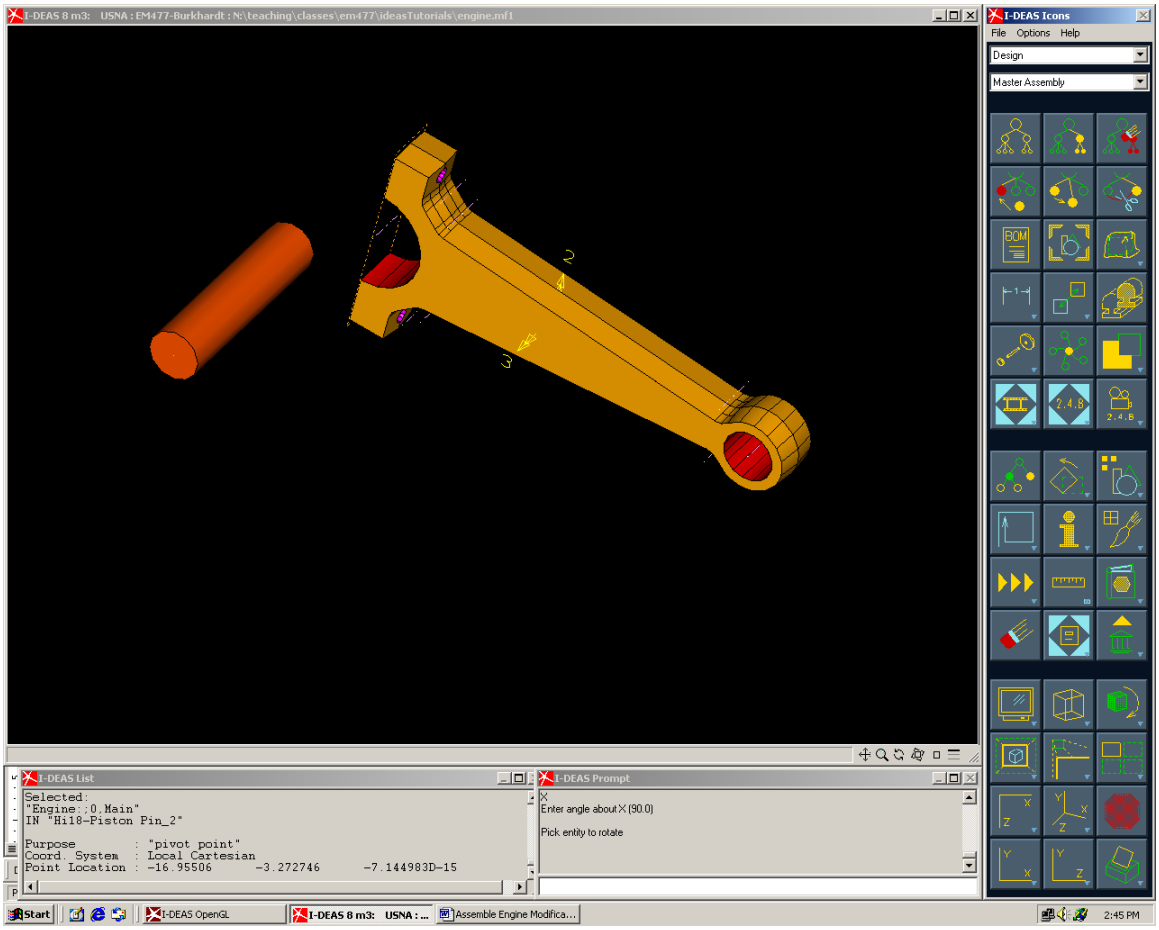
25. Add the Piston and Piston Pin to the Engine assembly by picking the **Hierarchy** icon. Select the top-level assembly. Pick **Add Empty Subassembly** icon and call it *Piston Assembly*. Select the Piston Assembly entry on the form, then pick the **Add Subassembly/instance** icon, **RMB**, **Get… From Bin/Library** and pick both the *Piston Pin* and the *Piston* (hold the Ctrl key to make multiple selections from the list)



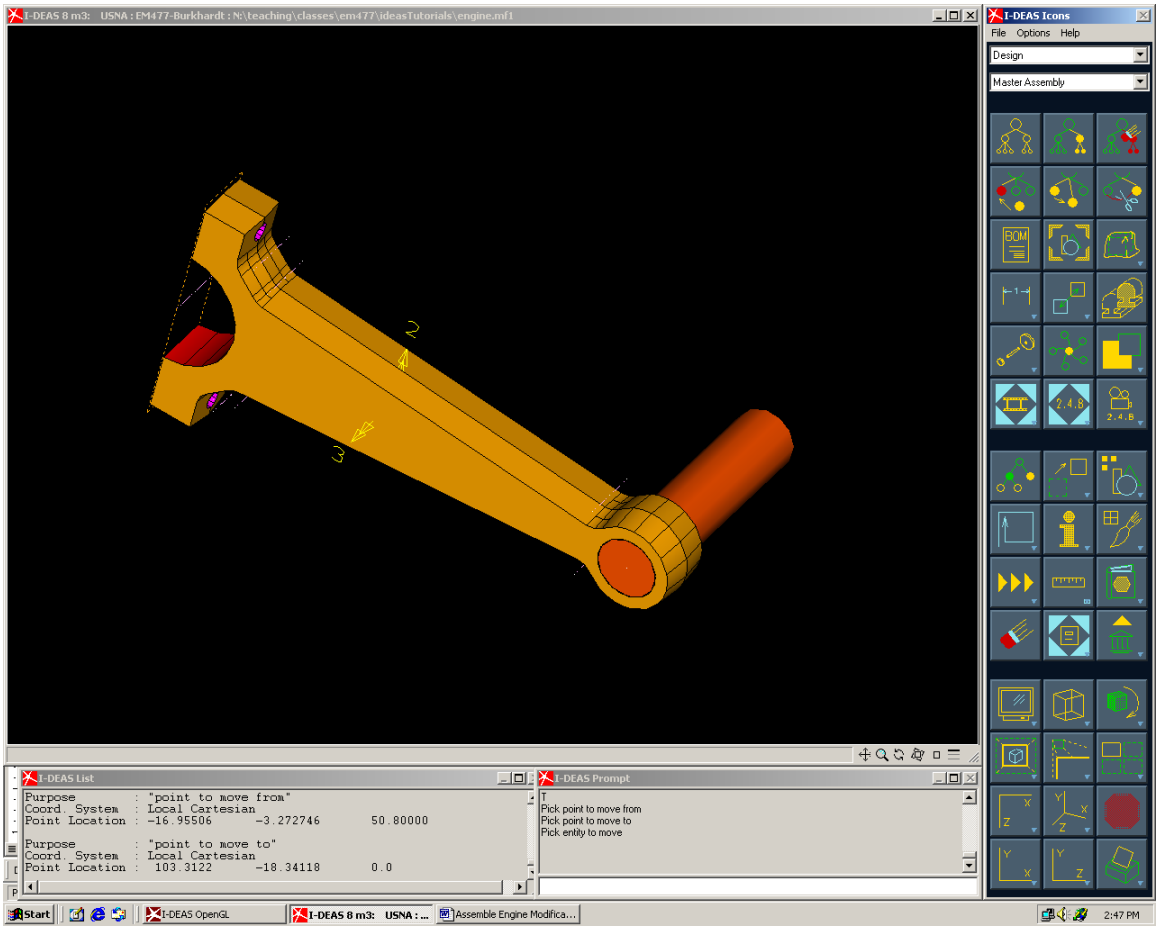
26. Suppress everything except for the Piston Pin and the Connecting Rod.



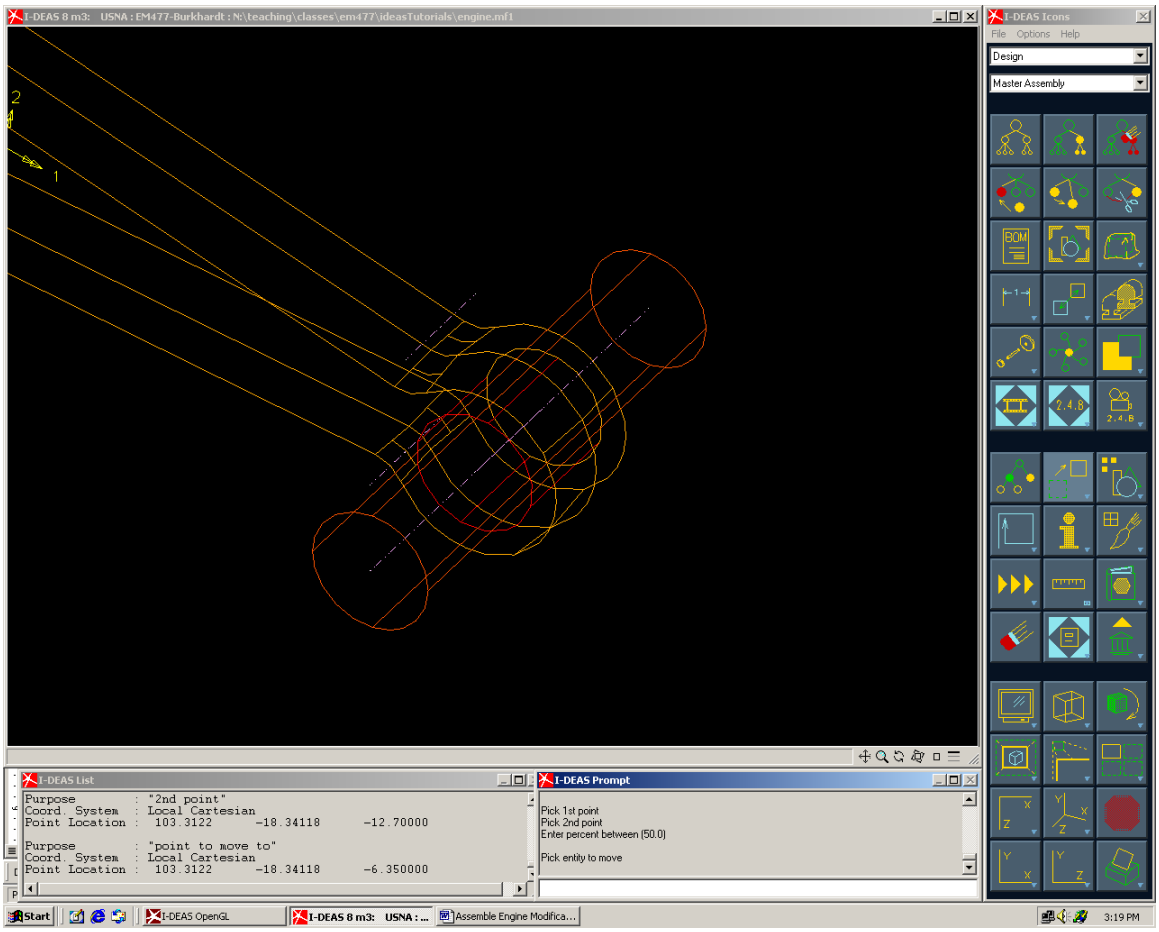
27. Rotate the Piston Pin 90^{o} using the **Rotate** command so that its axis is collinear with the axis of the wrist pin bearing.



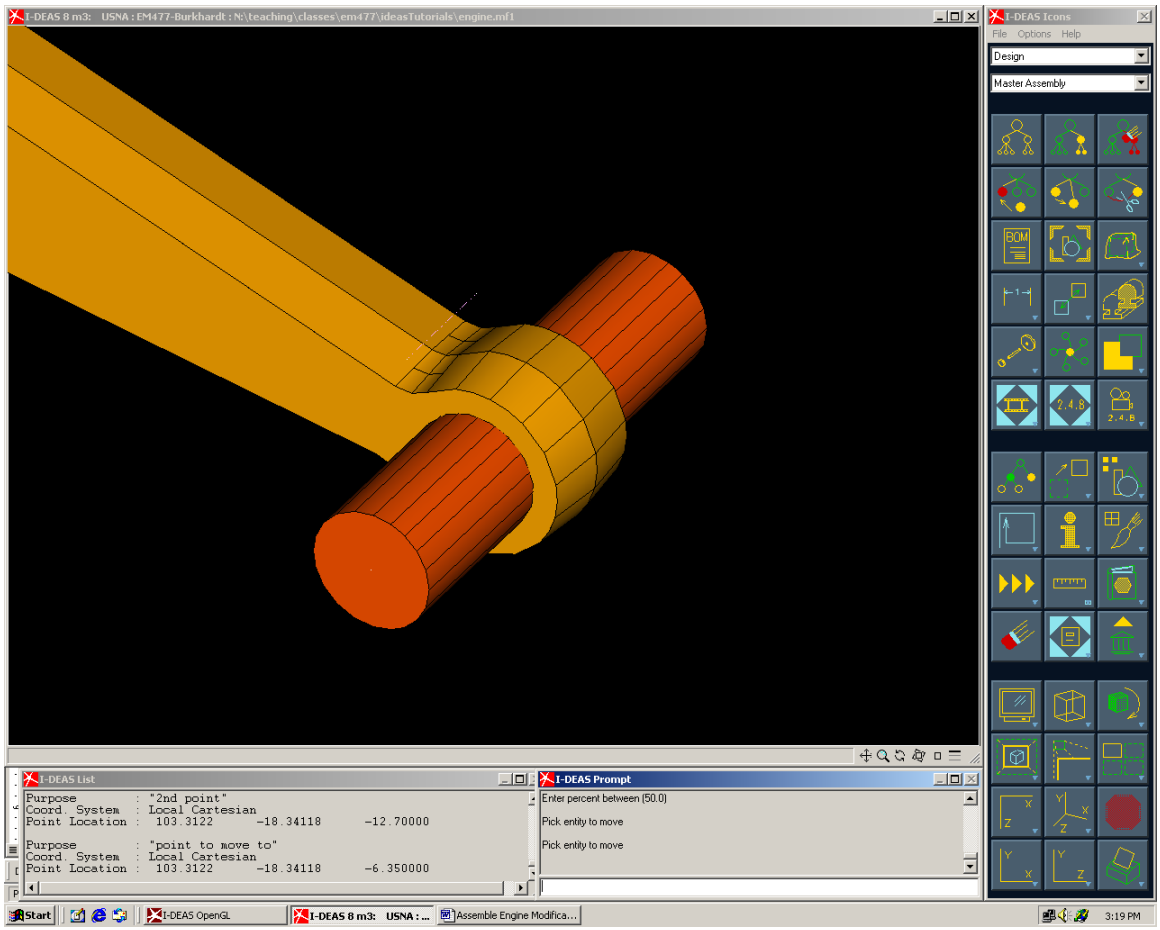
28. Now move the Piston Pin using **Move** so that it is aligned with the wrist pin axis.



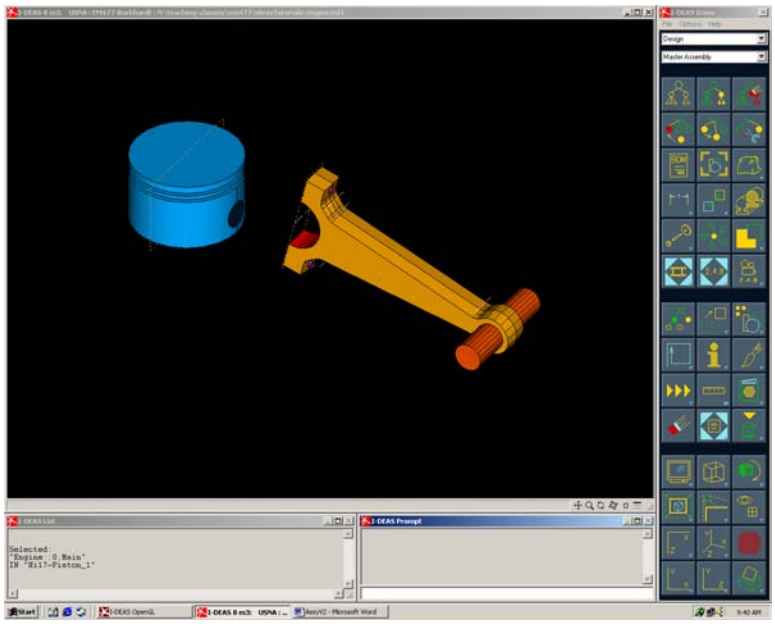
29. Now translate the pin so that it is centered on the Connecting Rod. Accomplish this by using the **Move** command along with the *Between* option to align the center point of the Piston Pin with the center point of the wrist pin. Display the model as a wireframe and zoom in on the Piston Pin. Chose **Move** and select the Piston Pin. To chose the point to *move from* **RMB** and choose *Between*. Select the centers of the circles on either end of the Piston Pin for the required two points. Choose the default 50% to locate the middle point.



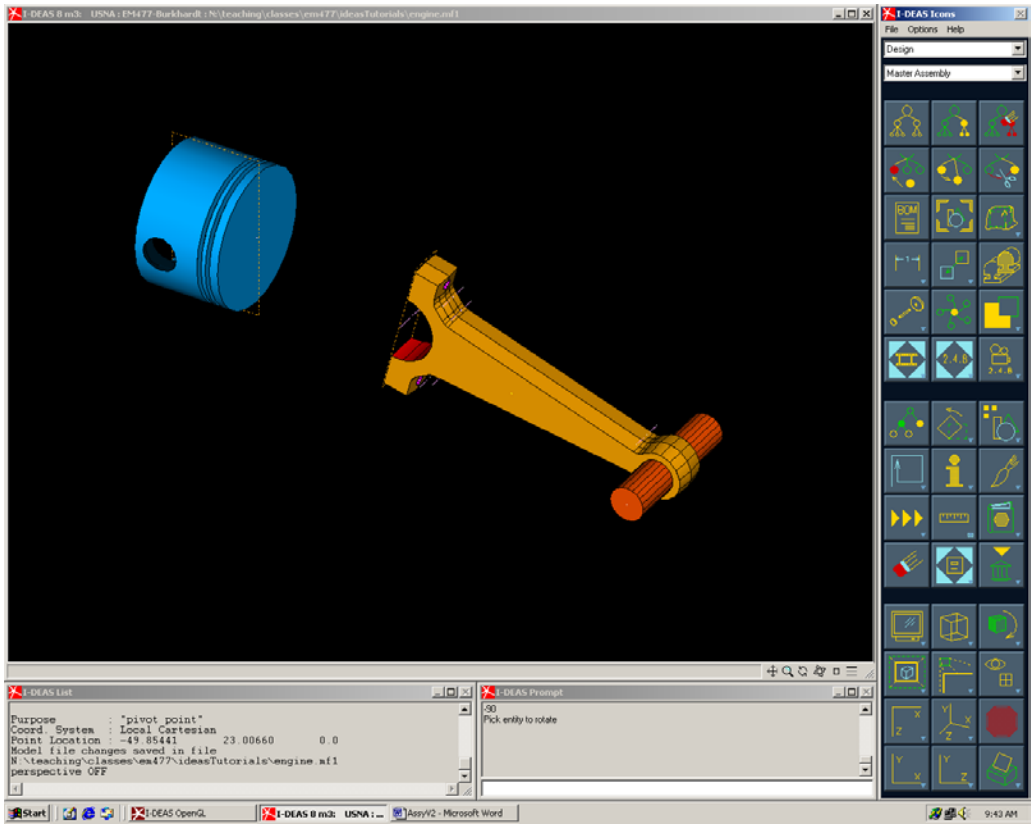
30. Next, without a prompt from I-DEAS, select the centers of the circles on either end of the wrist pin opening for the required two points. Choose the default 50% to locate the middle point of the wrist pin opening.



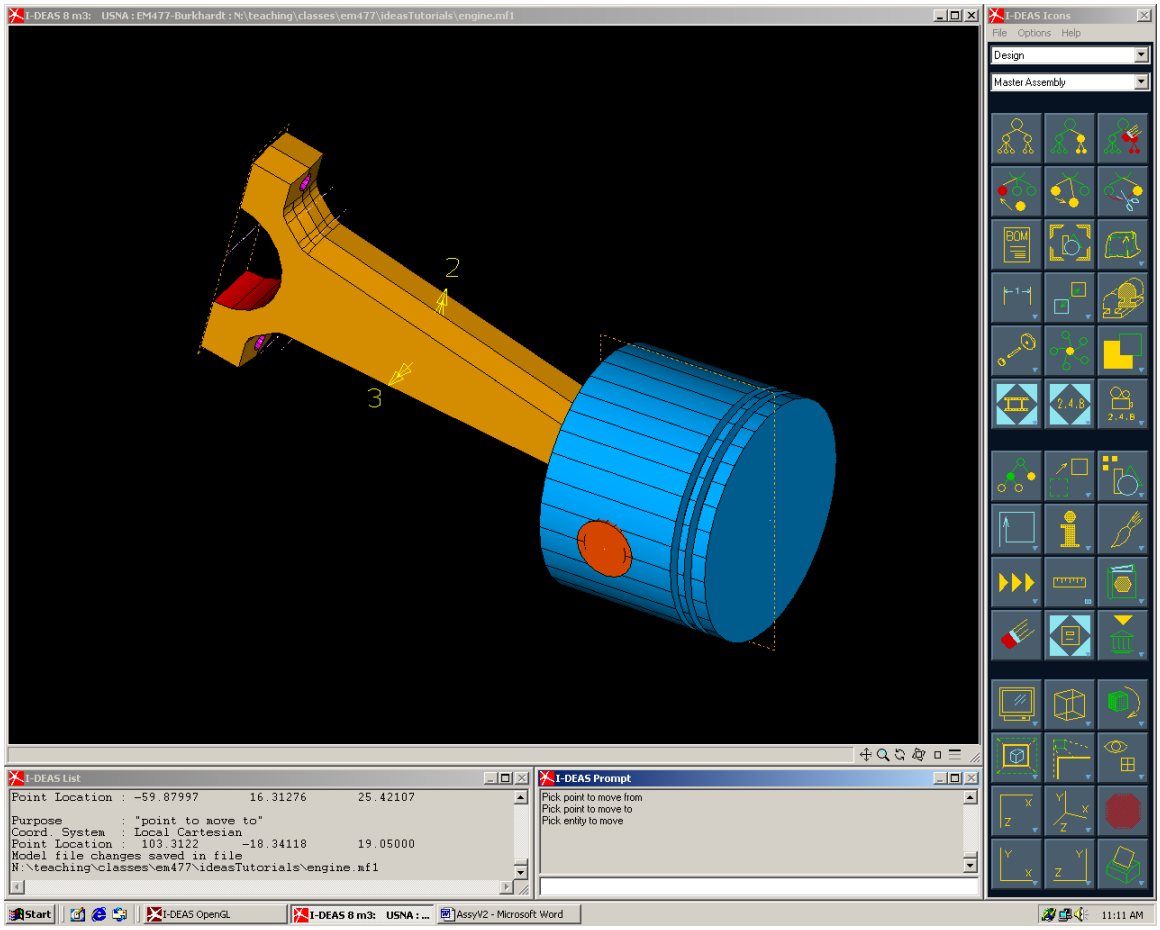
31. Unsuppress the piston,



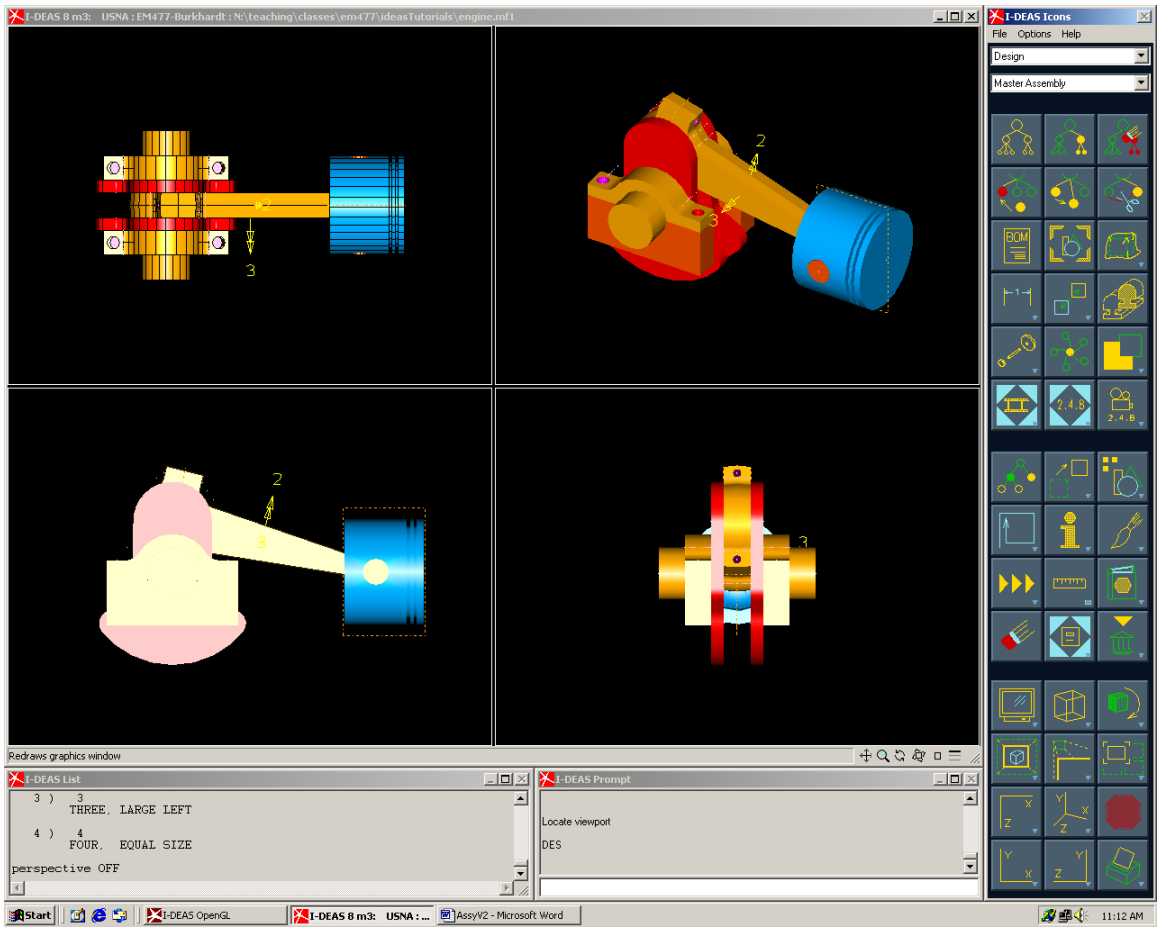
and rotate it 90^{o} twice using the **Rotate** command so that the axis of the Piston bore and Piston Pin align.



32. Now **Move** the Piston so that it is aligned on the Piston Pin. Use the center of the Piston bore and the center of the Piston Pin in combination with the *Move To* option.



33. Unsurpress the entire assembly.



Your assembly should look like the one shown. Save your model file and move on to the next tutorial.